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Industrial Residue Management Alternatives for Allegheny County (Pittsburgh) Pennsylvania

Environmental Quality Systems, Inc.
Rockville, MD

Prepared for

Robert S. Kerr Environmental Research Lab.
Ada, OK

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INDUSTRIAL RESIDUE MANAGEMENT ALTERNATIVES FOR ALLEGHENY COUNTY (PITTSBURGH) PENNSYLVANIA

by

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This study was conducted
in cooperation with
Bureau of Environmental Planning & Development
Allegheny County
Pittsburgh, Pennsylvania

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Major generators of wastewater treatment, air pollution control and production process residues in Allegheny County, Pa., were identified and contacted for the determination of current and future amounts of residues generated. Data developed through the survey and a literature review were utilized to estimate total residue generation by all industrial sources within the county. Estimates for 45 categories of industrial residues are presented for 1977 and 1983.

Information on current residue reclamation, treatment and disposal practices by industries in the county is presented. A computer analysis of costs for transporting wastes to several proposed central treatment facility locations within the county was performed.

Three alternatives for management of projected residue quantities within the county were formulated. A cost analysis of the alternatives found that an environmentally acceptable management plan for all residues generated within the county could be implemented at a total cost comparable to maintaining existing practices.

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FOREWORD

The Environmental Protection Agency was established to coordinate administration of the major Federal programs designed to protect the quality of our environment.

An important part of the Agency's effort involves the search for information about environmental problems, management techniques and new technologies through which optimum use of the Nation's land and water resources can be assured and the threat pollution poses to the welfare of the American people can be minimized.

EPA's Office of Research and Development conducts this search through a nationwide network of research facilities. As one of these facilities, the Robert S. Kerr Environmental Research Laboratory is responsible for the management of programs to: (a) investigate the nature, transport, fate and management of pollutants in ground water; (b) develop and demonstrate methods for treating wastewaters with soil and other natural systems; (c) develop and demonstrate technologies to prevent, control, or abate pollution from the petroleum refining and petrochemical industries; and (d) develop and demonstrate technologies to manage pollution resulting from combinations of industrial wastewaters or industrial/municipal wastewaters.

Increasing concern over human health and water pollution associated with land disposal sites has dictated that research be performed to establish sound technical and cost-effective schemes for disposal of a variety of types of solid residues in heavily populated and industrial regions. This report contains the findings of a study to inventory the industrial solid wastes within Allegheny County, Pennsylvania, and to develop a regional management plan for projected residue quantities.

Clinton W. Hall

Clinton W. Hall
Director
Robert S. Kerr Environmental Research Laboratory

ABSTRACT

Major generators of wastewater treatment, air pollution control and production process residues in Allegheny County, Pennsylvania were identified and contacted for the determination of current and future amounts of residues generated. Data developed through the survey and a literature review were utilized to estimate total residue generation by all industrial sources within the county. Estimates for 45 categories of industrial residues are presented for 1977 and 1983.

Information on current residue reclamation, treatment and disposal practices by industries in the county is presented. A computer analysis of costs for transporting wastes to several proposed central treatment facility locations within the county was performed.

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This report was submitted in fulfillment of Grant No. S-803550-01 by Environmental Quality Systems, Inc. and the Allegheny County Department of Works under the sponsorship of the U.S. Environmental Protection Agency. This report covers the period August 1, 1975 to July 31, 1977, and work was completed as of January 1978.

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SECTION 1

INTRODUCTION

One of the heaviest concentrations of major industry in the world is in Allegheny County, Pennsylvania. The Mononaghela River Basin supports the largest concentration of steel-making capacity in the United States. There are over 1,300 individual establishments listed in the 1976 Pennsylvania Industrial Directory, and Pittsburgh is the third largest "home-base" for U.S. corporations.

Handling, treatment and disposal of residues often constitutes the most costly single phase of water quality management programs. In Allegheny County, the types and quantities of residues are expected to constitute a more significant problem than in other metropolitan areas in the U.S. because of the large complex of industries.

In early 1975, the Allegheny County Department of Works undertook an examination of the problem of industrial residue generated in the county. The study was assisted by partial funding from the U.S. Environmental Protection Agency. Environmental Quality Systems, Inc., of Rockville, Maryland was engaged to perform the analysis. The U.S. EPA funding was on a demonstration basis since an effort of this magnitude had not been undertaken before in a highly complex industrial-urban area in the U.S. Since a wide base of previous experience is not available, the information which was developed during the course of the work and presented in this report must be considered preliminary in nature.

This is the report of a study effort, the results of which have led to a preliminary design, the first step in implementing a full-scale program. During the next step, the preliminary design effort will develop more detailed cost estimates, examine in detail the interest of industry to participate further in the implementation program, and include a more detailed analysis of treatment process and disposal options.

The study was conceived as an early step by Allegheny County to meet the growing demands upon industry imposed by future federal actions. The 1972 Amendments to the Federal Water Pollution Control Act (PL 92-500) required best practicable treatment (BPT) at the present time and even more stringent treatment requirements in the 1980's. The 1977 Amendment reinforced the industrial pollution control requirements. It is clear that current treatment requirements will generate more treatment process residues, sludges, brines and other materials.

Additionally, while the study was underway, the Toxic Substances Control Act, and the Resource Conservation and Recovery Act, were passed by Congress and were signed into law in the fall of 1976. These two pieces of federal legislation place controls on the management, handling and disposal of thousands of industrial chemical products and intermediates. The regulations pursuant to these two pieces of legislation are expected to have two primary impacts: (1) a significant expansion of the types of residues likely to come under federal regulatory control; and (2) a subsequent increase in expenditure by industry to meet growing and more encompassing environmental quality control requirements.

Legislative requirements for environmental quality controls could potentially affect maintaining or increasing the level of employment above current levels. A cost effective approach to residue disposal based on a detailed examination of available alternatives could assist the impacted industries and be a positive factor in retaining industries in the county. A successful industrial waste residue management program in the county would also be a positive factor in attracting new industry. Assisting existing industry and attracting new industry was considered a primary objective of the study.

Although the iron and steel industry is the major employer in the county, metal fabrication, foundries, smelting, stampings, forgings, tools and die making, and equipmment and parts manufacturing are industries which collectively comprise a significant portion of the industrial activity of the county. Over 100 different types of industries produce a complex variety of process residues, waste treatment and air pollution control residues which must be disposed of in environmentally sound ways.

Small manufacturers and processors are likely to be most affected by new regulations related to environmental quality control, and an objective was to develop disposal alternatives for smaller industry. Some of the residue types examined, therefore, including waste oil, waste solvents, sludges from metal finishing operations, waste foundry sand, caustics, industrial organic sludges and waste paint, while small quantities when viewing the entire residue production picture, represent significant potential environmental contaminants and also represent wastes from smaller operations.

The larger industries, particularly the iron and steel industry, produce the largest quantities of residues. The large industries possess the technical capability and often the financial resources to solve these problems. These industries could be assisted, however, by financing approaches which would minimize capital expenditures by industry. Another objective of the study was to examine alternatives which would be of assistance to large and small industries.

Other specific objectives of the study included:

1. Identification and classification of all industrial residues produced in Allegheny County (wastewater treatment residues; air pollution control and process residues).

2. Estimation of the total current and future quantities of these residues.

3. Determination of alternatives and costs for collection and transportation of various residues which could be treated and/or disposed of at central locations.

4. A preliminary examination of management alternatives for implementation, financing and administration for industrial residue management to meet environmental quality standards and the needs of industry.

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SECTION 2

CONCLUSIONS

1. A significant quantity of sludges and other process residues from waste water treatment, air cleaning and industrial manufacturing operations are produced each day in Allegheny County and the disposal of these residues places a significant burden on industry. As residue quantities increase and disposal options become more constrained because of new laws and regulations, the disposal costs will increase.

2. Steel mills and other primary metal industries, plating and coating operations, foundries, non-ferrous metal industries, food industries and others with residue disposal requirements will be most directly affected. The lack of a satisfactory disposal program for residues could adversely affect jobs in Allegheny County.

3. Treatment processes and residue disposal alternatives which will meet the regulatory requirements that are likely to be in force within the next 20 years have been evaluated. Preliminary cost estimates based on residue quantities in 1985 have been developed for three alternatives. These alternatives are:

- Alternative A - Initial program using existing technology; excluding residues for which disposal practices are considered best state-of-the-art.
- Alternative B - Later program using technology under development; again excluding residues for which disposal practices are considered best state-of-the-art.
- Alternative C - Similar to Alternative B but excluding most residues from steel industry and from publicly-owned sewage treatment plants. Steel industry and publicly-owned sewage treatment plants are of such magnitude that solutions other than centralized facilities may be selected.

For the categories of wastes included in Alternative A, current quantities and disposal costs are presented. Costs and quantities for the three alternatives and comparable current costs and quantities are presented with and without transportation.

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Using available technology (Alternative A), a system can be implemented with annual costs approximately the same as current levels but with the new system handling approximately 40% more residues.

Preliminary assessment of Alternative B, which depends to some extent on technology development and therefore requires further evaluation, indicates that annual costs and costs per ton should not exceed the costs for Alternative A. Alternative B would require a considerably larger capital cost but would be handling a substantially larger amount of residue. Both alternatives (A and B) include environmentally acceptable treatment, handling and disposal techniques.

Alternative C, which does not include most of the steel wastes but is directed at the smaller generators of wastes, would cost less than one-half of current costs, on an annual basis, but would handle only about one-third of the wastes currently being handled. Unit costs for alternative C would be higher than the unit costs for the other alternatives considered because of losses in economies of scale.

4. Assuming no change in the current disposal techniques and no increase in current unit cost estimates, the annual costs for disposing of future quantities in a facility which would meet environmental standards is within the range of and probably less than existing cost.

5. Unit costs - per ton of residue handled, treated, and disposed of - decrease with increasing quantity of residue managed in a central system. Value of recovered resources such as metals, acids, solvents, etc. is likely to reduce unit costs even further. The range of types of residue to be managed in the county has the effect of reducing unit disposal costs, since value of recovered resources from one treatment-disposal unit operation could offset costs of others.

SECTION 3

RECOMMENDATION

Given the current climate of intense public and regulatory scrutiny of hazardous waste disposal practices, the county should act immediately to insure that acceptable treatment, disposal and recycling outlets remain available. Lack of such a comprehensive plan could result in the stagnation or decline in the industrial base of the county in the next decade.

The development of a county-wide residue management and disposal system should proceed to the next phase - preliminary design. This phase should include securing agreements with residue suppliers, final selection of unit processes and more detailed cost estimates.

SECTION 4

CURRENT AND FUTURE RESIDUE AMOUNTS

DETERMINATION OF SOURCES OF RESIDUE

A significant portion of the effort in the study was directed toward the collection of residue data and generating estimates of residues, both current and projected, for those industries where data were not available. Industrial data was developed by contacts with relevant individual industries. Where additional data was required, residue generation estimates were derived from literature values or by association with comparable industries. Residue quantities were estimated for non-industrial wastes such as, crankcase oil, municipal wastewater treatment sludge, septage and water treatment residue. In these cases, unit generation values were developed for each source category and were applied in relation to the facilities of each individual site. For example, standard sludge generation values for several unit operations in municipal wastewater and water treatment, such as conventional activated sludge, extended aeration, and alum coagulation, were developed. These values were applied to individual plants based on knowledge of the type of plant and estimates of what process technology would be used for future applications.

An in-depth review of all of the several thousand manufacturing, service and commercial establishments within the county was beyond the scope of this study. Industries were selected for detailed examination on the basis of a priority system including flow, waste characteristics, employment, and an examination of an industry-type basis including such factors as air pollution control residue production, handling and storage of process chemicals and intermediates, need for pretreatment and treatment facilities and other factors. A description of the priority system is given in Appendix A.

The current and projected residue quantities in five major categories and a variety of subcategories are presented in Table 1. The five major categories include waste oil, solvents, organic wastes, inorganic wastes, and other wastes.

Table 1 contains estimates of quantities currently being produced and projected 1983 quantities. Residue amounts that are recycled on-site or within the same company are not included in the table. The projection of future quantities is based on estimating quantities of residues resulting from application of best practicable treatment (BPT), best available treatment (BAT) and zero discharge requirements. In addition, industry growth in

TABLE 1. ALLEGHENY COUNTY DAILY RESIDUE GENERATION (wet basis)

	(BPT 1977) # ind.	 kkg	 tons	(BAT 1983) # ind.	 kkg	 tons
A. Oily Wastes (totals)	60	98	108	60	105	116
1. WWT sludge	34	2.3	2.5	34	2.3	2.5
2. Machinery lubricants	3	.2	.2	3	.2	.2
3. Hydraulic oil	0	0	0	0	0	0
4. Emulsions	5	4.0	4.4	5	4.0	4.4
5. Animal oils & fats	5	1.5	1.7	5	1.5	1.7
6. Cutting oil	12	45	50	12	51	56
7. Tank bottoms	1	2.4	2.6	1	3.5	3.9
8. Crankcase oil*	*	43	47	*	43	47
B. Waste Solvents (totals)	26	11	12	22	11	12
1. Paint manufacture	16	8.9	9.8	15	8.9	9.8
2. Resin manufacture	1	0.69	.76	1	0.69	.8
3. Metal cleaning	5	0.90	.99	5	0.90	1.0
4. Printing, litho.	4	0.17	.19	1	0.17	.2
C. Organics (totals)	64	1180	1300	65	1210	1330
1. Food processing	5	16	18	5	16	18
2. Pharmaceuticals	0	0	0	0	0	0
3. Coal fines	5	520	573	4	520	573
4. Municipal WWT	43	640	705	43	670	739
5. Cleaning emulsions	9	3.8	4.2	10	6.5	7.2
9. Other organics	2	.004	.004		.004	.004
D. Heavy Metal-Containing Wastes (totals)	110	2210	3410	100	3500	4900
1. Iron hydroxide	6	1100	1200	5	2140	2360
2. Metal finishing	18	91	100	16	92	101
3. Spent pickle liquor-H_2SO_4	15	420	460	13	420	460
4. Spent pickle liquor-HCl	0	0	0	0	0	0
5. Air pol. control dusts (APC)	5	61	970	4	4	1000
6. Scrubber sludges	11	510	560	11	520	560
7. Scale	26	9.7	10.7	22	279	308
8. APC dusts (foundry)	24	19	21	24	20	22
9. Other	5	1.5	1.6	5	1.5	1.6

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* Based on daily accumulations at an estimated 600 service stations in the county.

(continued)

TABLE 1 (continued)

	(BPT 1977) # ind.	 kkg	 tons	(BAT 1983) # ind.	 kkg	 tons
E. Inorganics (totals)	88	11460	13390	90	10850	11950
1. Foundry sand	25	96	106	25	96	106
2. Iron slag	10	4300	4750	9	3400	3750
3. Steel slag	8	3200	3550	7	2200	2400
4. FGD sludge	1	510	1300	3	1700	1900
5. Cullet, glass manufacture	3	4.2	4.6	4	5.6	6.2
6. Cement dusts	5	100	110	6	100	110
7. Water treatment	28	1500	1650	28	1600	1750
8. Fly ash	8	1750	1950	8	1750	1950
F. Other Hazardous Wastes (totals	33	99	109	34	140	150
1. Acids	0	0	0	0	0	0
2. Caustics	6	9.3	10.3	6	9.3	10.3
3. Organics	5	22	24	5	22	24
4. Waste paint, dye	15	5.6	6.2	15	5.6	6.2
5. Inorganics	3	4.0	4.4	3	4.0	4.4
6. Coke production	2	38	42	3	85	94
7. Pitch sand, tar	2	20	22	2	20	22
County Total	381	15060	16600	371	15840	17460

each of the residue generating industries was estimated through 1985. Growth estimates are based on Pennsylvania industrial production values (1).

In Table 1, there appears to be little difference in residues generated for specific industry groups between BPT and BAT levels. In some cases, the amount of residues predicted under BAT requirements is actually less than current estimates. At the present time, most industries are providing treatment at the BPT level. BAT requirements often do not result in significant increases in residue production over BPT. Typically, BPT will remove high percentages of the raw waste load (generating a proportional amount of residue). The imposition of BAT, then, will typically remove a small amount of pollutant in relation to the raw waste load. For some industries BAT includes the recycling wastes, with little or no waste treatment requirements. In these cases, the residue generation rates will actually decrease significantly. It must also be noted that in some cases BAT levels have not been identified by EPA. In the absence of firm requirements, residue generation was assumed to be the same for BPT and BAT.

Three hundred and ninety-two industries were examined during the study with the activity distribution shown in Table 2. Residue production information was developed for 254 industries, with source coverage shown in Table 3. The largest industries representing about 85% of the employment of those industries examined and about 54% of the total County employment, provided information and data which appear in the results. Residue data and information was generated for industries representing the remaining 15% of employment. Where data were not available directly from the source, or from Pennsylvania Department of Environmental Resources files, estimates were made on the following bases in the priority order given:

1. If pollutant concentrations of both the raw wastewater and the treated effluent of an industry were known, residue generation was calculated on a mass balance basis, using estimates of percent sludge solids and treatment chemical additions.

2. If actual data were not available either from the telephone survey or from the files, and residue estimates were made using industry production data (see Appendix C). A limited amount of production information was available from federal and state discharge permits.

3. Employment data from the Pennsylvania Department of Commerce were used to estimate production and corresponding residue amounts from the remaining industries (2).

The prediction of residue amounts likely to be generated in Allegheny County in the future depends on four variables. These variables are:

1. Rate of industrial and population growth.

2. Development of improved manufacturing technology resulting in process modifications which reduce waste generation.

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TABLE 2. INDUSTRIES BY GENERAL CATEGORIES

SIC	TITLE	Number	%
20-39	Manufacturing	281	72
49	Public Utilities	72	18
70-79	Services	14	4
40-47	Transportation	12	3
50-51	Wholesale Trade	8	2
12-15	Mining	5	1
12-79	Total	392	100

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TABLE 3. DATA SOURCE COVERAGE

Data Source	Number of Industries and % of Total	Employment and % of Total
1. Telephone Survey (actual data)	79 (31%)	74,000 (85%)
2. Actual Data - other sources	83* (33%)	4,800* (6%)
3. Wastewater Data	13 (5%)	2,000 (2%)
4. Production Data	23 (9%)	2,000 (2%)
5. Employment Data	56 (22%)	4,000 (5%)
TOTALS	254 (100%)	87,000 (100%)

* Includes 71 municipal wastewater treatment plants and water treatment plants for which employment figures are not included.

3. Development of reuse/recycle technology resulting in utilization of a portion or all of currently generated residues.

4. Extent of enforcement of air and water pollution control legislation and regulations.

Where estimates of future residue quantities were available directly from the industrial sources, these variables were used.

All sludges in Table 1 are given on a wet basis; typical percent solids for categories of wastes are given in Appendix C. Not all the quantities will necessarily require transportation, either in the initial or the later total program. The detailed alternatives and their development are discussed in a later section.

DATA GATHERING AND GENERATING METHODOLOGY

Estimates presented in Table 1 were made in five different ways as discussed below.

Telephone Survey

At the outset of the study, the best method to obtain residue amounts was thought to be through predictions based on wastewater influent and effluent concentrations. Actual industry contact was favored for the following reasons:

A. Amount of process and dry air pollution control residues could be obtained. The scope of the study had been expanded to include these residues. An alternative method for estimation of maximum total amounts of residues generated through air pollution control is presented in Appendix G.

B. Much of the wastewater data included in National Pollutant Discharge Elimination System (NPDES) applications - a primary source of influent/effluent data - is out of date and incomplete for various reasons.

C. To characterize wet volumes of residues, needed for transport requirement estimates and treatment system design, estimated values of percent solids and percent increased quantities from additional chemical treatment are required.

The highest priority industries (see Appendix A) were contacted on an individual basis to gain actual, current information on residue generation. In addition, all major industries in the county with greater than 500 employees and/or wastewater flow greater than 0.1 million gallons per day (MGD) were contacted. The 103 industries in the survey were contacted first by introductory letter, then by telephone, and asked to provide information on present and future residue generation rates, residue characteristics, wastewater discharges and treatment provided, employment, production and current residue management practices. Response to the survey was excellent with over 97% of the industries contacted providing the requested information. Appendix B contains a copy of the Industrial Residue Telephone Survey form, and a table presenting the detailed results of the telephone survey by industry type.

Actual Data - Other Sources

Limited amounts of actual industrial residue generation data were obtained from files of the Pennsylvania Department of Environmental Resources (DER):

1. Solid waste permit applications.
2. Industrial solid waste survey (1968).
3. NPDES and DER discharge permits.

Residue data for municipal wastewater treatment and water treatment facilities were available from the Pennsylvania Comprehensive Water Quality Management Plan (3). Current residue data were available from the Allegheny County Health Department for electric generating and steam supply facilities.

Influent/Effluent Wastewater Data

If both pollutant concentrations of the raw wastewater and treated effluent of the industry were known, residue generation was calculated on a mass balance basis. Percent solids and treatment chemical additions were based on literature values for specific treatment processes (4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18). Values were developed for use in the prediction of residue amounts based on production and are presented in Appendix C-2, "Residue Generation per Unit of Product Produced." Appendix C-2 includes data from the telephone survey, other actual data sources, EPA development documents and other sources.

Production Data

For those industries where production data were available, residue generation was based on production. A limited amount of production information was available from federal and state discharge permits, the Pennsylvania Water Quality Management Study, and EPA development documents.

Employment Data

Employment data were available for all the industries (2). As a last resort, employment data were used to make residue estimates. A table was developed listing production per employee values based on the telephone survey, the U.S. EPA development documents, the Pennsylvania Water Quality

Management Plan data, Allegheny County Sanitary Authority (ALCOSAN) data (19), and Pennsylvania Department of Commerce data (see Appendix C).

(NOTE: Before the original approach was abandoned, a significant body of data on raw wastewater characteristics was developed; pollutant generation by industry type is summarized in Appendix D.)

RESIDUE CLASSIFICATION AND DISTRIBUTION

The residues have been classed into the 38 subcategories as shown in Table 1. Residues were classified in the same group based on:

1. Similarity of type of disposal approach.
2. Similarity of treatment approach or resource recovery option available.
3. Type of transportation required, i.e., tank truck versus open top.

The residue quantities obtained through the telephone survey, other data sources and data generated through the course of the study were entered for each industry in a computerized data base which can be modified as time passes and new information is gathered. The information is presented in two different ways: residue generated by individual industries, Appendix E, and residue totals by collection district within Allegheny County, Appendix F. The information includes industry identification number for the purposes of this study, the name of the municipality within the County, the zip code mailing area, the discharge point, employment information, production quantities, and BPT residue quantities and BAT residue quantities generated by the individual industries. This information can easily be kept current as new industries move into the area and/or residue quantities change in the future. The delineation of collection districts is based on a previously-developed Allegheny County solid waste management plan (13); these delineations may or may not be preserved to implement a residue management program. The districts were useful to locate quantities within the County and to develop residue transportation cost estimates which are discussed in a later section. Ten of the residue types account for approximately 95% of the total current (1977) and future (1983) residue generated as shown in Figure 1 and Figure 2. Iron and steel slags account for about one-half of the total residue production. Fly ash, sludges from water treatment plants and iron hydroxide sludges from the treatment of pickle liquor account for another one-fourth of the total residues.

These large quantities, however, tend to obscure the relative importance of smaller quantities of potentially hazardous organic and inorganic residues generated within the county. An estimated 2,300 metric tons of potentially hazardous wastes are currently generated within the County, a figure projected to increase to 3,700 metric tons per day by 1983 (see insets Figures 1 and 2). Environmentally sound treatment and disposal or recycle of these wastes should be the primary objective of the county-wide residue management plan.

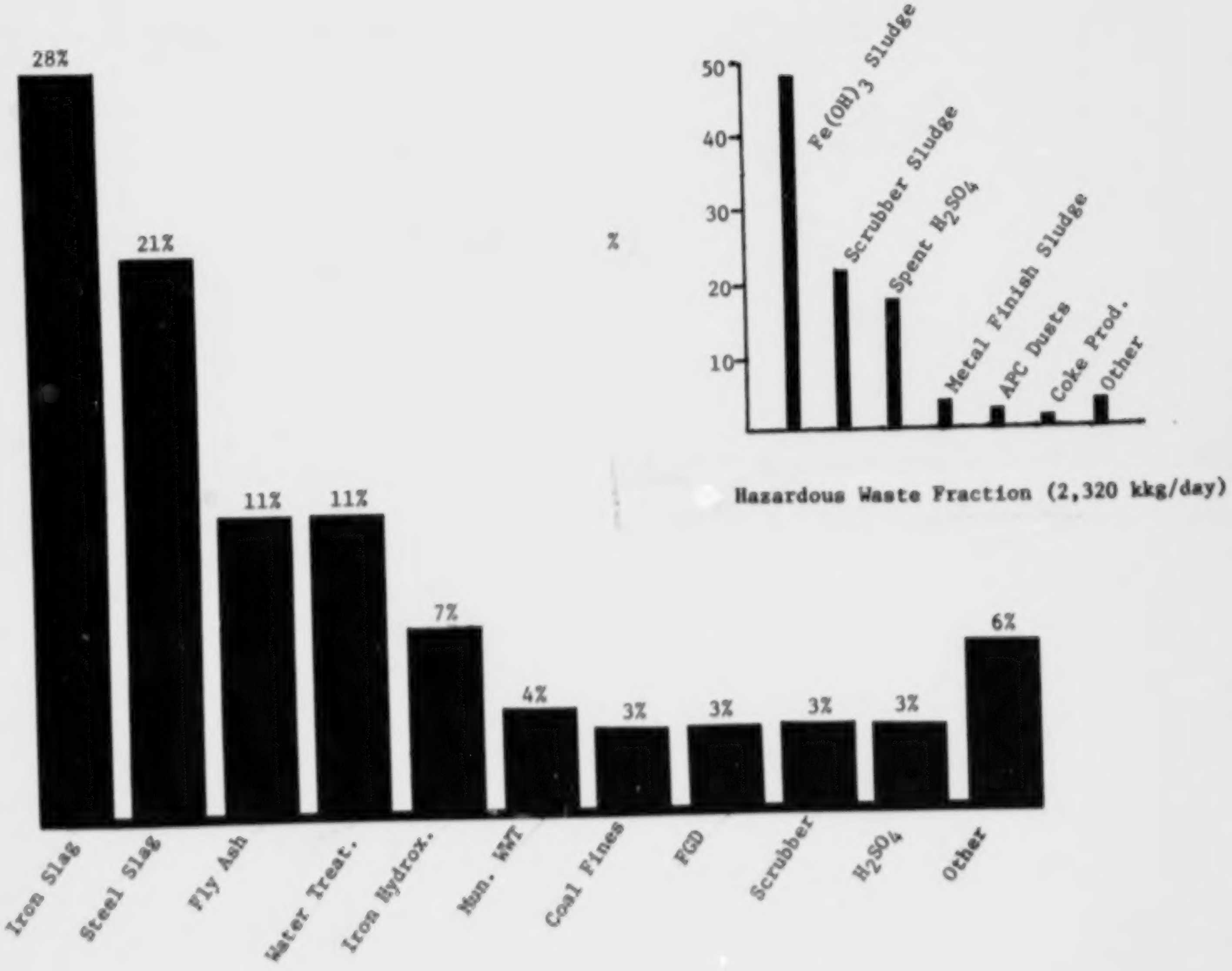

FIGURE 1 - 1977 MAJOR RESIDUE CLASSIFICATIONS (15,060 kkg/day)

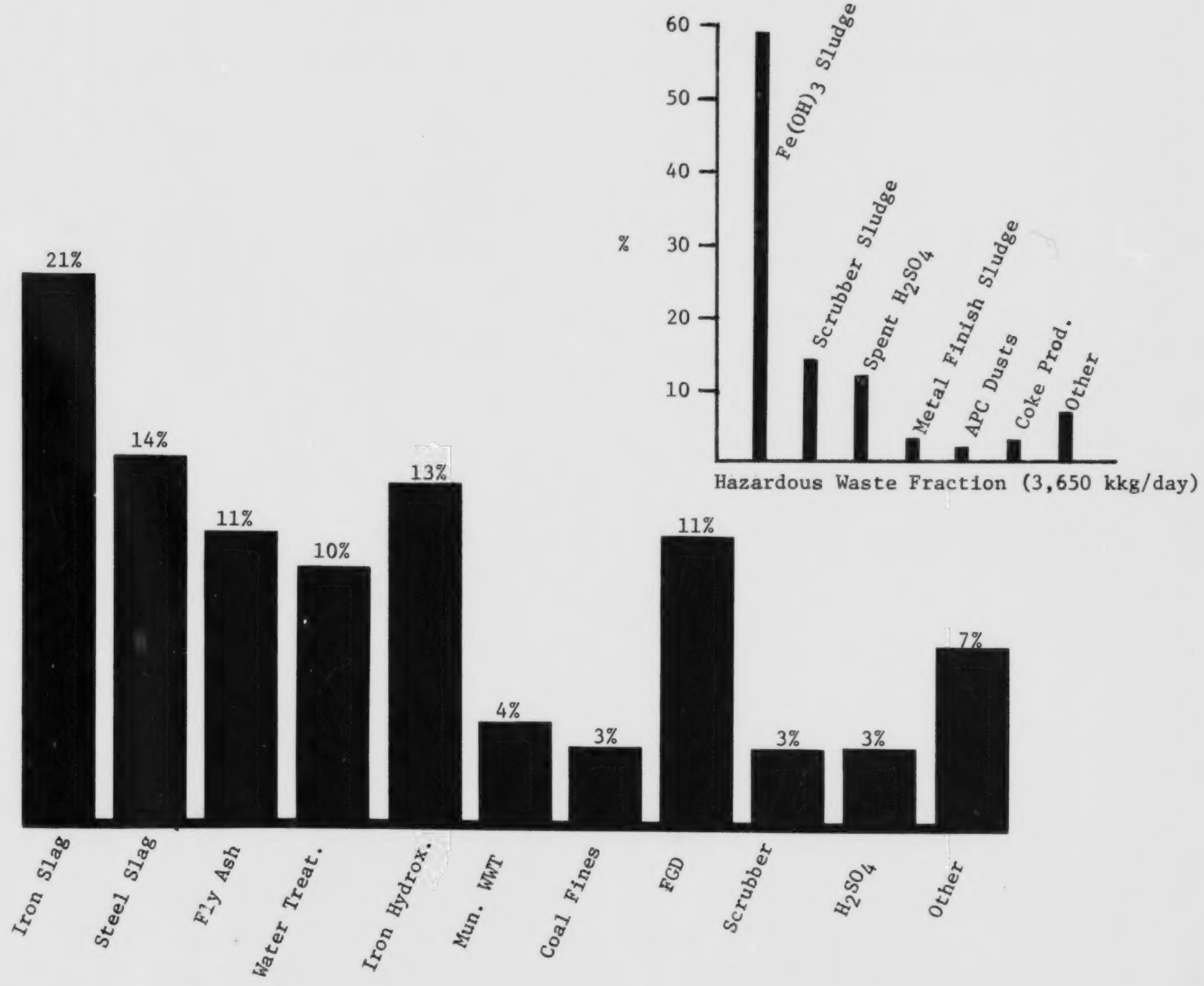

FIGURE 2 - 1983 MAJOR RESIDUE CLASSIFICATIONS (15,840 kkg/day)

MAJOR RESIDUE GENERATING INDUSTRIES

Much of the material in this section was developed from questionnaire responses as well as conversations during the survey. Some technical information and data were derived from technical references where given and from EPA development documents to supplement the available information.

Integrated Steel Mills (SIC 3312)

Large integrated steel mills encompass a series of distinct unit processes, each generating different types of residue. The major unit processes with corresponding residue characteristics and disposal approaches are described below (14, 15).

By-Product Coke Plant--

Coke, along with iron ore and limestone, is one of the three basic raw materials utilized for iron production. Coke is formed by heating metallurgical grade coal without air; volatile components driven off are processed in the by-product plant resulting in the recovery of chemicals. A recovery operation will produce tar, ammonium sulfate, surplus gas, light oil and ammonia. A variety of residues are produced at different stages of the operation. These residues are:

1. Coke breeze - small particle coke formed during the quenching process. Settled out of the quench water in collection sumps, it may be totally reused within the mill as fuel.

2. Pitch, tar, naphthalene - tars and heavy oils are condensed from the gases at several points in the process, with most of the tars and oils being sold or further processed to chemicals. Waste tars are generated at distillation units, naphthalene condensed in the final cooler, contaminants cleaned from sedimentation basins and other sources.

3. Wastewater treatment sludge - contaminated process water is generated in several ways:

    a. excess ammonia liquor - initial cooling of the gases with flushing liquor condenses water originating from coal moisture (including effluents from the ammonia still).

    b. final cooler water blowdown - contact cooling of the saturated gas following tar and ammonia extraction.

    c. light oil recovery wastes - condensed steam and cooling water from benzol recovery.

    d. barometric condenser blowdown - generated by the ammonium sulfate crystallization process.

Wastewater containing high concentrations of ammonia, cyanide, oil and grease, phenol, sulfides and suspended solids is generated. Treatment methods including physical treatment, biological treatment, sorption and incineration are available. Operation of the ammonia still to remove fixed ammonia from the ammonia liquor adds lime or caustic to the waste stream, increasing sludge generation. Increased treatment requirements for these wastewaters are expected in the near future.

Blast Furnace--

Residues generated in the operation include coarse flue dust from dust catchers and sludge settled from scrubber water, used to remove particulates from the gas streams. Polymer addition to scrubber water may be used to facilitate settling. In Allegheny County all of these residues, dust and sludge, are recycled to the blast furnace via sintering operations, thereby eliminating disposal problems. Most of the iron slag currently produced is processed for metal recovery and the remainder is sold for use in construction and road building.

Steelmaking--

Steel is formed from iron through the refining of impurities, carbon, silicon, sulfur, phosphorus and manganese from the metal in either open hearth (OHF), basic oxygen (BOF) or electric air furnaces (EAF). The BOF, the dominant process used locally, utilizes oxygen fed by high pressure lances for the oxidation of impurities. The OHF is still utilized in two locations in the county. The EAF, which will replace the OHF at one major location by 1979, utilizes scrap iron exclusively as a charge, whereas the OHF process uses up to 25% scrap.

As with the blast furnace, residues arise from gas cleaning equipment. Venturi scrubbers are used for BOF gasses, with the resultant effluent treated by sedimentation basins. Wet scrubbers, electrostatic precipitators and baghouses are used for the cleaning of OHF and EAF gasses. These residues are difficult to recycle due to high zinc and lead concentrations and the major part is currently landfilled.

Much research has been devoted by the industry in recent years to develop recycling methodology for these materials, and technically feasible processes do exist; however, they are currently reported to be too expensive for implementation by individual companies. Recycling of these materials in the near future will be dependent on a number of variables: environmental regulations relating to sludge disposal, improvements in recycling technology, domestic raw material availability, prices of foreign supplies, and other economic factors.

Steel slag is currently stored in piles without further treatment or processing.

Specialty Steelmaking--

Specialty steels include stainless (greater than 4% chromium) and alloy steels which contain manganese, silicon, copper or have significant concentrations of aluminum, cobalt, columbium, molybdenum, nickel, titanium, tungsten, vanadium or zirconium added to obtain desired properties. Alloying elements are added to impart strength, hardness, heat resistance and corrosion resistance. Electric arc furnaces have become the dominant process for specialty steels, but one of the major producers in the county utilizes a hot blast cupola and BOF for stainless steel production. Residues arising from either wet or dry gas cleaning equipment may be more attractive for application of metal recovery technology due to high concentrations of alloy metals such as chromium and nickel. A major reclamation facility for these residues, under development by a firm in Beaver County, is scheduled for operation by mid-1978.

Hot Rolling--

Forming and finishing of raw steel from ingots is accomplished by primary and secondary hot and cold rolling mills. Primary mills produce intermediate slabs, blooms and billets; these intermediates are increasingly being produced by continuous casting machines, eliminating the need for primary mills. Secondary mills produce finished products and intermediates such as structural sections, rails, plates, hot strip and sheet, skelp, rods, bar, and hot formed pipes and tubes. Other forming processes performed by integrated steel mills include cold finishing of pipes and tubes, wire drawing and forging of hot steel.

Residues generated in hot rolling operations arise from scale (oxides) which continuously forms and is removed from the hot metal and from excess lubricating oils which are applied directly to the metal being formed. Methods of scale removal during hot rolling include high pressure water sprays, scarfing (melting up to ¼ inch of the hot metal surface by applying jets of oxygen), grinding, milling, and hand and machine chipping. Cooling water from roll application along with scale-laden water from the surface cleaning operations, flow through flumes below the equipment to scale pits where heavy iron oxides settle out. The scale pits are followed by primary clarifiers for further suspended solids removal and oil skimming. Currently, virtually all scale accumulated in these processes by integrated steel mills in the county is recycled through sintering facilities to the iron and steel furnaces. Some of the waste oil is collected by private firms within the county, but most is landfilled. Secondary treatment of scale pit effluents through deep-bed sand filtration, reactor clarifiers and more efficient oil removal, will be in effect by 1983 and this will result in increased residues. The extent of future recycling of these residues is uncertain.

Pickling--

Before cold rolling and coating, surface oxide (scale) is removed from the hot rolled metal by chemical reaction with hot acid (pickling). In Allegheny County, sulfuric acid is still used almost exclusively for pickling, although there has been a trend in recent years to hydrochloric acid elsewhere. Residues include spent pickle liquor, sludge from treatment of spent pickle liquor, acid rinse and fume scrubber effluents.

Spent sulfuric acid pickle liquor is a significant waste source in the area. The largest generator neutralizes and discharges the resultant flow to lagoons on company-owned slag disposal sites. Other major generators depend on contract haulers that take the untreated pickle liquor outside the county for disposal.

Acid rinse water combined with fume scrubbing effluents are considerably more dilute than the spent pickle liquor and are currently discharged without treatment by several major mills. Treatment of this waste stream will be required by 1983, resulting in significant additional quantities of residue.

Cold Rolling--

Cold rolling mills produce coils of uniform strip and sheet much thinner than those produced by hot rolling. These thin coils are used by the container manufacturing and construction industries. The sheet and strip, hardened by the cold rolling process, is heat treated by batch or continuous annealing furnaces to give it formability. The sheet and strip is then rolled to final specifications in temper or Sendzimir mills, or sent to final coating lines.

A water-oil emulsion is sprayed directly on the metal and rolls for cooling and lubrication; the emulsion is usually reused by utilizing a collection and recycling system. Residues arise from batch discharges of spent rolling solutions and from some of the mills that use once-through systems. If the roll is to be coated, oil and dirt must be removed prior to annealing, often by caustic electrolytic cleaning. Oily residues arising from the joint treatment of these waste streams are either landfilled on-site or removed by contract haulers.

Coating--

Products from hot and cold rolling mills are often given protective or decorative coatings before shipment. Common coating operations include halogen, acid, and alkaline tin plate lines, electrolytic chromium plating, hot-dip aluminum, alloy plating, and organic compound coatings.

For proper adhesion of coating materials, the surface is prepared and cleaned of all surface contaminants. Oil lubricants applied in the temper mill and protective oil coatings are removed in solvent or caustic cleaning tanks. After initial cleaning, the metal is usually pickled as described above. The coated strip is often given a final chemical treatment and rinsed with water to remove dragged-out plating solutions, excess treatment chemicals and other contaminants.

Concentrated electrolytic plating solutions are continuously purified via ion exchange and filtration to eliminate the need for dumping valuable chemicals because of contamination. Spent cleaning solutions and rinse waters from various stages of the coating operation are usually collected together for treatment. These contain a variety of heavy metals, solvents and other chemicals. Treatment of spent solutions and rinse waters by neutralization, polymer addition and clarification results in sludge containing chromium, tin, zinc, lead and other heavy metals; the sludge is currently landfilled or stockpiled, as reclamation of metal values by individual companies is not currently being practiced. Quantities of this type of sludge will probably increase by 1983 as more raw waste streams, primarily rinse water, receive treatment and more effective treatment processes are placed into operation.

Electric Generating Plants (SIC 4911)

Air pollution control equipment generates residues at electric generating facilities either through dry or wet collection systems. Three major generating stations within the county, Phillips (Wireton), Calfax (Cheswick) and Elrama (Elrama station straddles the Allegheny-Washington County line), generate residues from coal fired boilers; the other two, Reed (Brunot Island) and Cheswick (Springdale), are currently oil-fired and generate no significant residues. Power plant residues are expected to significantly increase by 1983 as a result of flue gas desulfurization to be installed at the Cheswick and Elrama facilities.

Coal utilized at the 3 plants averages 17% ash and 2% sulfur. The ash is collected as residue through fly ash and bottom ash collection systems. Dry mechanical collectors and electrostatic precipitators account for all fly ash removal at Elrama and Cheswick, and 75% of the fly ash at Phillips; the remainder of the fly ash from the Phillips facility is removed by the wet FGD scrubber system. Discharges from sluicing systems which collect ash from the bottom of the boiler furnaces are treated by sedimentation basins; sludges that accumulate in the basins are disposed of with the fly ash. Bottom ash accounts for an average of 15% of the ash total.

A flue gas desulfurization system is currently in operation at the Phillips station and under construction at Elrama. Both plants use the Thiosorbic (proprietary process of Dravo, Inc., Pittsburgh, PA) lime wet scrubbing process consisting of 5 to 6% magnesium oxide (MgO) added to the lime (CaO) solution. The scrubbers remove approximately 90% of the sulfur dioxide and most of the remaining 25% of the fly ash. The effluent flows to settling basins, with resulting sludge (35 to 50% solids) underflow generation rates comparable to fly ash residues (approximately 500 metric tons per day).

Other sources of wastewater at electric generating facilities include coal pile runoff, cooling water blowdown, water purification waste, boiler water blowdown and sedimentation basin effluents. Residues may be expected if more stringent controls are implemented.

Dry fly ash collected at the Colfax station is slurried and pumped to an abandoned mine for disposal. FGD sludges are difficult to dewater, but fixation agents have been developed recently which solidify the sludge in a relatively short time (10 days). At the Phillips station, the FGD sludge is pumped to curing ponds where it hardens, and is excavated, mixed with the fly ash, and trucked to a landfill. Similar treatment is planned at Elrama.

Water Treatment (SIC 4941)

The 28 major municipal water treatment plants within the county generate residues by turbidity removal and water softening operations. Formerly, much of the sludge generated was returned to the rivers, a practice which is gradually being eliminated.

The unit processes employed are usually coagulation, floculation, sedimentation, filtration, and disinfection. All processes except disinfection produce residues. Coagulant aids include natural and synthetic organic polymers as well as inorganic salts such as aluminum sulfate, sodium aluminate, ferrous sulfate, ferric sulfate, and ferric chloride.

Surface and ground water supplies within the county are characterized by high hardness; values of 250 mg/l and higher are common. Hardness, caused by divalent metallic ions, is removed by either the lime-soda ash process or ion exchange. Quantities of residue produced depend directly on the type of process utilized and the amount of hardness to be removed. Actual data on quantities of softening sludges were not available and were estimated for the 15 plants employing softening (25). Current disposal methods include discharging to municipal wastewater treatment systems, directly to a stream, or to landfills.

Wastewater Treatment (SIC 4952)

Allegheny County is currently completing a separate study, with the Pennsylvania Department of Environmental Resources (DER) on sewage sludge management; the resultant quantities estimated in that study are included herein (26). Values entered for current residue generation in the data base were obtained from preliminary figures developed in the DER plan. Maximum residue amounts are based on the assumption of secondary treatment for all current sewage discharges; future amounts could be larger if additional advanced treatment requirements are imposed on county treatment plants.

The large Allegheny County Sanitary Authority system (180 MGD capacity) generates about 75% of the county sewage sludge. Current treatment and disposal methods at ALCOSAN include vacuum filtration, incineration and ash landfill. Sludge disposal at the 35 other major treatment plants within the county is primarily landfill after preliminary drying of the raw sludge by sand beds or vacuum filters.

Coal Preparation (SIC 1211)

Residues considered in coal mining and preparation activities include those generated from treatment of acid mine drainage and effluents from beneficiation processes. Acid mine drainage is treated at four major deep mines in the county. Mine drainage treatment may consist of neutralization through lime addition, aeration for ferrous iron oxidation and precipitation as ferric hydroxide, followed by sedimentation lagoons. Accumulated sludge may either be left in the lagoon after it has been filled and a new operation begun, or periodically removed and disposed of on gob piles. Residue generated fluctuates with the variable iron and acid concentrations and volumes of the effluents, dependent on seasonal rainfall variations.

Coal preparation plants process the coal for designated uses, primarily for power production and metallurgical coke production, by crushing, sizing and removal of inert ash materials. Following preliminary crushing, the coal is washed for removal of mineral matter and hydraulic separation of the high grade coal. Effluents from this process, having suspended solids concentrations of up to 25% (primarily coal fines), are discharged to slurry ponds for sedimentation. Sludge settled in the lagoons accumulates until capacity is reached. Currently one reclamation plant recovers the coal values from the sludge.

Cement (SIC 3241)

Raw materials including lime and smaller amounts of silica, alumina and iron are finely ground and fed to a kiln where temperatures of 1600°C turn the mixture to clinker. The clinker is ground with small amounts of gypsum to a fine powder constituting the final product. As the kiln rotates, much of the fine material becomes airborne and is carried out by gasses. The dust particles are collected by cyclones, electrostatic precipitators and baghouses. Two major cement manufacturing facilities produce residue primarily made up of kiln dust.

Much of this dust can be recycled directly to the kiln, depending on alkali content; one of the plants maintains a 75% recycling rate. High-alkali dust is also landfilled; recovery of soluble alkali by leaching may be possible but currently is not practiced.

Organic Chemicals (SIC 2821, 2869)

Four major chemical plants utilize byproducts from coke and petroleum manufacturing as raw materials for the production of intermediates utilized in the plastics and coatings industry, such as cumene resins and solvents, maleic anhydrides and phthalic anhydrides. Significant amounts of polyester resins are manufactured at a major plant characterized as a paint manufacturer (2851) and an adhesives and sealants plant (2891).

Phthalic anhydride is an intermediate compound, used in plasticizer and resin manufacturing, produced through the oxidation of naphthalene. Residues generated consist primarily of light and heavy ends from purification stills and periodic process water discharges. Gaseous waste streams from the reactor and distillation units (high in organics) are incinerated.

Maleic anhydride is an intermediate compound used mainly in the production of polyester resins. It is also used in the manufacturing of pesticides, surface coatings, plasticizers, lubricants, fumaric acid and maleic acid. The compound is formed through the oxidation of benzene in a fixed-bed reactor followed by recovery of the product through condensation and subsequent scrubbing of the remainder from the off-gas followed by dehydration.

The product then undergoes fractionation for purification. Residues generated include light and heavy ends from the dehydrator and fractionator, excess water from the decanter (used in the dehydration process) and effluents from periodic equipment washings. Contract haulers handle either the untreated effluents or dilute sludges from coagulation and sedimentation basins.

Unsaturated polyester resins are used primarily in the production of plastics reinforced by glass and metal or natural fibers; the resins are also used in molded plastics, castings, solder and surface coatings. Residue generation originates from three sources. These sources are the water of reaction contaminated with glycols, acids and solvents; recirculated scrubber water blowdown with BOD and chemical oxygen demand (COD) concentrations of up to 400,000 parts per million (ppm); and caustic cleanout solutions used in periodic cleaning of reactors, tank cars and tank trucks.

Current disposal methods primarily involve collection of all of the concentrated waste streams with subsequent contract hauling to landfills. One major resin and coating producer delivers its caustic cleanout wastes to an out-of-state chemical reprocessor where it is reclaimed.

Foundries (SIC 3321, 3325, 3361, 3362)

Five iron (3321), six steel (3325) and 14 non-ferrous foundries in the county produce three classifications of primarily dry residues. These dry residues are air pollution control dusts, waste casting sand and slag. Air pollution control dusts are collected in electrostatic precipitators and baghouses and contain significant amounts of casting sand as well as metallic particles.

A typical production process at a foundry starts with melting of a charge of metal, primarily scrap, in an induction furnace with addition of a flux for the removal of oxides forming a slag which is skimmed off. Volatile elements such as zinc, phosphorous, sulfur, arsenic, cadmium and magnesium are entrained in the furnance off-gases and collected by air pollution control equipment. The melted metal is then poured into sand-lined molds, solidified, removed and cleaned of sand. Exhaust air flow from the process carries entrained sand and binders, phenolic compounds, which are usually removed by the same air pollution control system, resulting in a mixed residue of metallic oxides, sand and binder materials. Spent casting sand and binders are collected by hydraulic and dry systems.

Reclamation of metallic values from air pollution control residues is currently not practiced; the residues, along with waste slag, are usually taken by contract haulers to landfills. Several foundry sand reclamation companies in surrounding counties handle some of the waste sand while the remainder is landfilled.

Paint (SIC 2851)

The primary residue producing process for water and oil-based paint formulation is the cleanout of mixing tubs between batches. Water-based (latex) paints consist of various proportions of acrylic resins, water soluble alkyd resins, extenders and pigments dispersed in water. Oil-based paints and lacquers contain drying oils (linseed) or alkyd resins for film-forming binders, extenders, pigments and volatile solvents. Major pigments utilized are titanium and zinc oxide, white and red lead, carbon black and various colored organics. Principal solvents include mineral spirits, toluene, xylene, naptha, ketones, esters, alcohols and glycols. Calcium carbonate, clays and silicates are used as extenders.

Final cleanup of oil-based paint mixing tubs is done by flushing with solvents or strong caustic solutions. Waste solvents from the process are either handled by solvent reclamation companies or taken to chemical landfills. Spent caustic cleaning solutions may be treated and discharged directly, discharged to municipal sewers, or containerized and landfilled. Effluent from clean-up of water-based paint tanks is amenable to biological treatment. On-site treatment and containerization of these wastes is practiced. One major production facility is currently installing a solvent recovery unit.

The paint formulators contacted within the county indicated that oil-based paint manufacturing with solvent wash is the principal process. Disposal or recycling of wastes containing a variety of contaminants based on the type of paint or coating manufactured constitute a major expense to the paint formulators. The current industry trend towards expanded development and use of water-based paints could reduce future disposal problems.

Metal Finishing (SIC 3471, SIC 3479)

Metal finishing is done not only at individual job shops but also as a part of the total production process at metal fabrication plants and integrated steel mills (described above). A captive finishing shop may be a part of almost any metal fabrication process. In Allegheny County, metal finishing is likely to be performed by the following industrial categories:

	SIC Numbers
Electroplating	3471
Coating, Engraving	3479
Printing, publishing	2711, 2751-2
Wire, wire products	3315, 3496
Structural metal products	3316, 3444-9
Metal containers	3411-2
Hand tools, hardware	3423-9
Plumbing, heating fixtures	3431-3, 3494
Bolts, nuts, screws	3451-2
Automotive parts	3465, 3711
Small arms	3484
Steel springs	3493
Turbines	3511
Metal working machinery	3541-9

Industrial machinery	3561-9
Computer, communication equipment	3573, 3661-2, 3674
Electrical equipment	3621-9, 3679, 3694
Railroad equipment	3743, 3462

All major metal fabrication plants in the above categories were contacted in the telephone survey to determine if a plating shop was operating.

Unit processes in a metal finishing shop may include cleaning of surface contaminants such as oil, grease or buffing compounds, removal of surface oxides and application of metallic or organic coatings. Initial cleaning often employs strong alkali phosphate solutions containing high concentrations of wetting agents. Solvent cleaning is also performed utilizing kerosene, benzene and trichlorethylene. Sulfuric acid pickling is the primary process for oxide removal; alkaline pickling solutions are used in etching of aluminum and zinc. Coating processes include electroplating, anodizing, phosphating, chromating, electropolishing and painting. Common electroplating process solutions include copper or zinc cyanide, copper or nickel sulfate or fluoborate and chromic/sulfuric acid solutions; many other types of solutions containing varying amounts of metals and complexing agents are utilized in metal finishing.

Wastewater and residue are generated through dumping of spent solutions (cleaning, pickling and plating), rinsing and accidental spills. Treatment practices for these effluents include cyanide destruction by chlorine or hypochlorite at high pH, reduction of hexavalent (Cr^{+6}) chromium with sulfur dioxide or other reducing agents at low pH, followed by neutralization and sedimentation for the removal of heavy metals as hydroxides. Polyelectrolytes are utilized in clarifiers to aid coagulation and settling of metallic hydroxides; oil, grease and solvents are removed by skimmers.

Typical clarifier sludge has a dry solids content of only 1 to 2%. Higher solids concentration (5 to 25%) is achieved through aging, decantation, and vacuum and pressure filtration. Segregation of wastes is desirable for both sludge dewatering and possible reclamation of metallic values. Currently, many metal finishing establishments discharge much of their waste flows directly to municipal sewage systems after neutralization.

Contract haulers handle most of the wastes generated, taking the waste to chemical landfills in other counties and surrounding states. Currently, there is no metal reclamation being practiced. Future sludge generation depends on a number of variables including changes in processing methods for chemical and water conservation and development of economical metal reclamation technology to be applied to sludges. Recycle of metals in plating solutions may be expected to be applied in all newly constructed facilities.

SECTION 5

RESIDUE RECLAMATION, TREATMENT AND DISPOSAL

CURRENT RESIDUE MANAGEMENT

Information on current industrial reclamation, treatment and disposal practices was based on contacts with cognizant personnel at industrial facilities. Over 100 major industries were contacted as part of the effort to collect data on industrial residue generation and disposal. While pertinent information was not received from all industries, the data collected represent the majority of residue production in the county. This section, then, is intended to provide an overview of current practices developed from available information.

Current Recycle and Reclamation of Residues: On-site

Residues that are recycled on-site or within the same company that generates the residue do not appear in the residue totals. Recycling and reclamation are currently practiced on the following residues:

Blast Furnace Dust--
All flue fines collected from dust catchers and wet scrubber systems are currently recycled through sintering facilities. Flue fines from ferromanganese blase furnaces are not as amenable to recycling. Currently, however, ferromanganese fines are not being generated due to the shut down of these operations in the county. The schedule and extent of future operations is, at this time, uncertain.

Mill Scale--
Virtually all mill scale collected in scale pits treating effluents from hot and cold rolling mills is recycled to blast furnaces via sintering plants. Residues generated by future treatment of liquid effluent from mill scale operations may also be reclaimable.

Coke Breeze--
Fine coke particles which settle out from coke quench water are reused, primarily as feed to the sintering plant. As air pollution control equipment is installed on charging and pushing operations, similar residues will be generated. It is assumed that these residues will be recycled to the same extent.

Sinter Dust--

The dust generated by sintering operations is collected by electrostatic precipitators and/or baghouses; additional residues may be generated by treatment of scrubbing and quenching effluents in clarifiers. All collected residue is recycled directly as feed to the sintering plants.

Kiln Dust--

Up to 80% of all kiln dust generated in cement manufacturing facilities and collected by air pollution control equipment is recycled directly to the kiln. High alkali dusts are undesirable as raw charge and are landfilled; reclamation of this fraction of the kiln dust through leaching of alkali materials is currently not practiced. One firm completely recycles molybdenum dust in its ferroalloy production process.

Coal Fines--

Several of the major coal preparation plants currently reclaim the coal value from the effluent of washing and upgrading operations. Coal recovery rates as high as 63% have been obtained. Settling pits (slurry ponds) can be considered as possible sources of materials for future reclamation if it becomes economically attractive. Slurry pond overflow at several plants discharges to sand beds.

Metal Finishing Sludges--

Several industries in the county currently produce no sludge because of recycling. Some metal finishing sludges such as those from rolling and forming operations are landfilled.

Steel Slag--

At least one of the integrated steel industries recycles its steel slag from basic oxygen furnace operations, reclaiming metallics and landfilling the remainder. Most steel slag is not recycled for recovery of metal value; crushing and demetallizing approaches, successfully applied to iron slag, have not been successfully applied to steel slag.

Solvents--

Several large chemical plants in the area recycle their solvents in closed loop processes. This practice will probably increase as costs of "fresh" solvents increase.

Metal Molds--

A potential waste, spent metal molds used in melting and casting operations, are usually recycled after they have been deformed by heat and/or chemicals. No residues are produced.

Current Recycle and Reclamation of Residues: Off-site

In addition to on-site reclamation of residues by generating industries, several private firms are currently recycling significant amounts of residues (Table 4). Private reclamation firms are active in the handling of the following residue classifications:

Blast Furnace Slag--

One company operates iron slag processing plants adjacent to major steel mills in Pittsburgh, Duquesne, Aliquippa (Beaver County), McKeesport, and Monessen (Westmoreland County). Molten slag from the blast furnaces is cooled in open pits, quenched with water, crushed, processed for iron reclamation, and then sold to construction and road-building firms for use in cement concrete, asphaltic concrete masonry units and various other construction materials. The Phillips Slag Company in Stowe Township similarly processes slag for a mill on Neville Island. The slag companies pay the mills for iron slag. Demand for processed iron slag is currently greater than the supply, prompting current reclamation efforts on old slag piles to a limited extent. A decrease in the construction of interstate highways in the future could reduce current demand levels.

Specialty Steel Wastes (flue dust, mill scale)--

A private firm is currently constructing a reclamation plant in Ellwood City, adjacent to Beaver County, scheduled to begin operations by mid-1978. The plant will process more than 40,000 tons per year of stainless and alloy steel manufacturing residues primarily generated in the Pittsburgh area. Three mills will apparently send wastes that are currently being landfilled. Flue dust, mill scale and grinding residue, difficult to recycle because of high zinc and lead content, will be converted via a proprietary smelting process to a stainless steel remelt alloy. Specialty steel pickling residues will not be handled by the facility under construction, but research is being conducted on possible reclamation processes which could be included in future plant expansion plans.

Waste Oil--

Several private firms handle a portion of the oily wastes generated by large steel rolling operations and metal fabrication plants. Their locations are listed in Table 4. However, most waste oils are still landfilled. Some reprocessing of the waste lubricants generated by sources such as newspaper printing, glass manufacturing and, to a lesser degree, service stations is practiced. These firms typically charge the waste generating facilities based on moisture or contaminant content of the waste oil. One of the firms in the area sells reprocessed hydraulic and cutting oil to bidders for use as road oil and in asphalt emulsion plants. Other industries sell their oily wastes and hydraulic oils to independent buyers for use as road oil. Several industries incinerate waste oils. One industry uses oily wastes for parking lot dust control.

Waste Foundry Sand--

Approximately 20% of the waste foundry sand generated in Allegheny County is cleaned and reprocessed for reuse. A firm in Westmoreland County and one in Pittsburgh purchase sand from two major foundries and then clean and resell the sand to the mills.

Spent Solvents--

Several private facilities collect and recycle waste solvents, often on a contract basis. Most of these private regeneration plants are located out-

TABLE 4. WASTES RECLAIMED BY PRIVATE FIRMS*

Location	Residues reclaimed
Pittsburgh	Foundry sand (E1)**
Connellsville	Foundry sand (E1), Foundry dust (D8)
Buffalo, New York	Solvents (B), Pickle Liquor (D3), Hydroxide sludge (D1),Hazardous chemical wastes (F)
Allegheny County	Blast furnace slag (E2)
Cleveland, Ohio	Caustics (F2)
Leery, Ohio	Spent solvents (B)
Ellwood City	Specialty steel wastes (D5, D7)
Stowe Township, Allegheny County	Blast furnace slag (E2)
Pittsburgh	Waste oils (A)
E. Liverpool, Ohio	Waste oils (A)
McKees Rocks	Waste oils (A)
Washington	Waste oils (A)
(Tri-State)	Radioactive wastes

*Based on the survey performed during this study.
**See Table 1 for waste classification code.

of-state; transportation costs are, therefore, significant. A manufacturer of printing ink in Allegheny County currently regenerates its own spent solvents, and a major manufacturer of paints and industrial coating is currently installing a solvent regeneration unit.

Caustic Chemical Wastes--

Caustic wastes generated by a scrap processing plant in the detinning of steel and by an industrial coating manufacturer in tank cleaning operations are handled by two out-of-state chemical reclamation firms. A firm in Cleveland, Ohio, accepts the detinning wastes for the reclamation of caustic chemicals and the firm charges only for transportation of the waste. The tank cleaning wastes are processed by a firm near Buffalo, New York. Values from pickle liquors, plating solutions, solvents, mercury sludges and other waste inorganic and organic chemicals are partially reclaimed.

Miscellaneous Residues--

A variety of other residues, ranging from metal scrap to spent brewery grains, are either recycled, sold or disposed of by a wide variety of techniques. Table 5 presents a summary of the reclamation or reuse methods. Note that not all wastes in the residue classifications shown are disposed of in the manner indicated in the table.

Current Treatment and Disposal Practices

For the remaining industrial residues classifications, reclamation and recycling currently are not practiced. These residues are either disposed of on-site by the generating industry or removed from the sites for a fee by contract haulers and disposed of at privately-owned landfills. Table 6 lists major on-site and company-owned disposal areas in the county and nearby areas. Fifteen known major on-site and company-owned disposal areas are operated which dispose to lagoons or landfills.

Twenty-one private contract hauling and disposal operations that handle industrial residues were identified. Table 7 lists the name, location, residues hauled, and disposal methods. All firms provide lagoons or landfills. Four firms provide neutralization services, and one provides incineration. The quantities currently handled at these facilities are limited.

Steel Slag--

Slag from steelmaking and foundry operations has not been found to be as amenable for use in the construction industry as blast furnace slag. Small amounts are utilized in sinter plants and as construction fill, after aging, but the major portion must be piled at disposal areas.

The Duquesne Slag Company handles disposal of these residues for at least four major steel companies. Its major disposal site is Nine Mile Dump in the City of Pittsburgh. Other major disposal sites are located in West Mifflin and in Penn Hills, Allegheny County. Slag generated at smaller specialty steel makers and foundries is collected and disposed of by contract haulers at several landfills throughout the area.

TABLE 5. MISCELLANEOUS RECLAMATION OR REUSE METHODS BY SELECTED INDUSTRIES

Residue classification	Disposal or use
Food Processing (C1)*	Spent grains sold to farmer
Air Pollution Dusts (D5)	Pelletized and stockpiled
Air Pollution Dusts (D5)	Sold to industrial users
Air Pollution Dusts (D5)	Stockpiled to await better technology
Scrubber Sludge (D6)	Sold for fertilizer
Scrubber Sludge (D6/C1)	Recycled to process
Mill Scale (D7)	Sold
Heavy-Metal Containing Residues(D9)	Metal scrap to foundries
Fly Ash (E8)	Sold for cinder roads
Fly Ash (E8)	Sold to municipality for road ice control
Caustics (F2)	Recovered by incineration. Sale recycled to paper and glass plants.
Caustics (F2)	Recycle

*See Table 1 for residue classification code.

Note that not all wastes within the residue classification are disposed of or used by the method shown.

TABLE 6. ON-SITE AND COMPANY-OWNED DISPOSAL AREAS

Name	Location	Residues	Disposal methods
Allegheny Ludlum Steel	Brackenridge	Mill scale (07), flue fines (D5), hydroxides (01)	Lagoons formed by slag dikes
Arco Polymers	Monaca	Proprietary	Proprietary
Consolidation Coal-Champion	S. Fayette Twp., Allegheny Co.	Coal fines (C3)	Lagoons
Consolidation Coal-Renton	Penn Hills Twp., Allegheny Co.	Coal fines (C3)	Lagoons
Edgewater Steel	Oakmont	Flue fines (D8)	Landfill
Glenshaw Glass	Shaler Twp. Allegheny Co.	Cullett (E5)	Landfill
J & L Aliquippa	Aliquippa	Wastewater treatment (A1)	Landfill
Kennametal	Delmont	Machinery oil (A2) and Scrubber sludges (D6)	Discharge to old 2,000 gal. capacity septic tank
Latrobe Die-casting	Latrobe	Hazardous organics (F3)	Landfill
Molycorp	Washington	Hazardous slag (F5)	Landfill in swamp area
Penreco-Pennzoil	Karns City	API separator oily wastes (A7)	Landfill
PPG	S. Greenburg	Cullet, glass mfg. (E5), air pollution dusts (D5)	Landfill

(continued)

TABLE 6 (continued)

Name	Location	Residues*	Disposal methods
Republic Steel-Russleton Mine	W. Deer Twp., Allegheny Co.	Coal fines (C3)	Lagoons
U.S. Steel-Brown	West Mifflin	Hydroxide sludge (D1), Waste oil (A6)	Lagoons on slag piles
U.S. Steel-Taylor	West Mifflin	Flue fines (D5), iron slag (E2), ash (E8)	Landfill
Vesta Washery (J & L)	California	Coal fines (C3)	Landfill to slurry pond/sand bed
Witco Chemical	Petrolia	Inorganic wastewater treatment sludge (E7), Fly ash (E8)	Landfill

* See Table 1 for residue classification code.

TABLE 7. PRIVATE CONTRACT HAULERS AND DISPOSAL FIRMS

Name	Location	Residues*	Disposal methods
Browning Ferris Industries	E. Palestine, Ohio	Solvents (B), Hazardous chemicals (F), Pickle liquor (D3, D4)	Incineration, chemical landfill, neutralization
Browning Ferris Industries	N. Fayette Twp., Allegheny Co.	Organic chem. (F3), Foundry dust (D8)	Lagoons, landfill
Crescent Township Landfill	Crescent Twp., Allegheny Co.	Fly ash (E8), FGD sludge (E4)	Landfill
Canistrale Sanitary Landfill	Monessen, Washington Co.	Hazardous chem. (F), Fly ash (E8), Oils (A)	Fly ash lined lagoons, landfill
CENCO-Industrial Wastes, Inc.	Darlington, Beaver Co.	Pickle liq. (D3), hazardous chemical (F)	Neutralization, lagoons
C. D. Cotrell	Westmoreland Co.	Hazardous chemical (F)	Lagoons
Duquesne Slag-Nine Mile	Pittsburgh	Steel slag (E3)	Landfill
G & G	Washington, Washington Co.	Hazardous chem. (F), solvents (B), Scrubber sludges (D6)	Landfill
Hauser Trucking	Millvale, Allegheny Co.	Slag (E3), Foundry dust (D8)	Landfill
Industrial Waste, Inc.	New Brighton, Beaver Co.	Pickle liquor (D3, D4), Iron hydroxide (D1)	Neutralization, landfill

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TABLE 7 (continued)

Name	Location	Residues*	Disposal methods
Kelley Run Landfill	Forward Twp., Allegheny Co.	Coke prod. wastes (F6), Oil (A), Foundry Wastes (D8)	Fly ash lined lagoons, landfill
Kissick Shaft Landfill	Harmar Twp., Allegheny Co.	Fly ash (E8)	Abandoned mine
W. D. Mays	Stowe Twp., Allegheny Co.	Organic chemicals (F3)	Landfill
Mill Services, Inc.	New Stanton, Weston Co.; Balger, Washington Co.	Pickle liquor (D3), Hazardous chemicals (F)	Neutralization, sedimentation lagoons
Mazzaro Landfill	N. Fayette Twp., Allegheny Co.	Air pollution dusts (D8, F9)	Landfill - strip mine
Pellegren, Inc.	Homer City, Indiana Co.	Air pollution dusts (D5)	Landfill
Phillips Landfill	Stowe Twp., Allegheny Co.	Cement dusts (E6)	Landfill
Rollins Env. Landfill	New Jersey	Hazardous chemicals (F)	Special landfill
R. Stasco	-	Slag (E3), Foundry dust (D8)	Landfill
U.S. Utilities Service. Inc., (Chambers Landfill)	Monroeville, Allegheny Co.	Oil (A), Hazardous chems. (F), Pickle liquor (D3)	Lagoons - fly ash lined

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* See Table 1 for residue classification.

Fly Ash and Flue Gas Desulfurization (FGD) Sludge--

These residues, although collected separately, are often combined for disposal at the Phillips Generating Station. The residues are not considered hazardous but due to the magnitude present a disposal problem (27). FGD sludges are comprised mainly of fly ash and calcium sulfate ($CaSO_4$) and are difficult to dewater; however, recent advances in stabilization technology have resulted in the development of fixation agents which solidify the sludge within a relatively short time. At the Phillips Station, fixation chemicals are added to the FGD sludge which is then pumped to curing ponds. The hardened sludge is excavated, mixed with fly ash, and trucked to a nearby landfill for ultimate disposal. At the Colfax Station in Cheswick, dry fly ash is slurried and pumped to an abandoned mine for disposal. Three quicklime scrubbers at the Elrama (Washington County) power station send fly ash and SO_x sludge at 35% solids by weight from a clarifier to vacuum filters. A proprietary fixation process is used to obtain sludge at 50 to 60% solids by weight, which is then sent to three clay-lined ponds. Sludge from the ponds is subsequently landfilled.

Iron Hydroxide Sludge--

U.S. Steel operates the Brown Disposal site for neutralized pickle liquor at its slag dumping area in West Mifflin. The spent sulfuric acid pickle liquor is neutralized at the plant and then transported to the disposal site where it is deposited in large lagoons dug into the slag piles. The thin sludge (2% solids) dewaters through evaporation and percolation of water through the slag piles.

Allegheny Ludlum Steel landfills acid rinse water neutralization sludges dewatered to 50% solids at its Brackenridge plant. Capacity of the site, consisting of slag dikes built into the Allegheny River, has been reached and a new landfill is under construction.

Spent Pickle Liquor--

For the other major pickling operations in Allegheny and Washington Counties, untreated spent pickle liquor is collected and disposed of in surrounding counties by contract haulers. Mill Services, Inc. operates two major treatment and disposal sites for spent pickle liquor and other chemical wastes in New Stanton, Westmoreland County, and Balger, Washington County. The acid wastes are neutralized in polyethylene-lined lagoons with effluents receiving further physical treatment before discharge. Three to five million gallons of waste per month are reportedly handled at these sites. Industrial Wastes, Inc. (CENCO) of Darlington, Beaver County, the other major hauler for spent pickle liquor, provides lime neutralization at its Folston site.

Other Industrial Residues--

The United States Utilities Service site in Monroeville, and the Canistrale Landfill in Monessen, Washington County, are not currently accepting pickle liquor but do dispose of coke production residues and other chemical wastes. The lagoons are revegetated when full. The Kelley Run Landfill in Forward Township disposes of coke production sludges, waste oil and foundry wastes in fly ash-lined lagoons. Browning Ferris, Inc. (BFI) operates a landfill near Imperial, Pennsylvania, for disposal of chemical wastes and a hazardous waste incinerator in East Liverpool, Ohio. The Imperial site deposits chemical plant and foundry wastes in fly ash-lined lagoons. Spent solvents and chemical wastes from several Allegheny County industries are incinerated and treated at the East Liverpool plant with residuals deposited in a chemical landfill at the site. Hazardous materials have been accepted at the C.D. Cotrell Landfill in Westmoreland County, W.D. Mays Landfill in Stowe Township, and Mazzaro Landfill near Imperial. The extent of current disposal of hazardous wastes at these sites is not accurately known.

Major on-site or company-owned disposal areas for industrial residues are operated by U.S. Steel and Allegheny Ludlum Steel. The U.S. Steel Taylor Disposal Site is utilized for flue fine residues dewatered to 80% solids from open hearth, basic oxygen and electric furnaces, as well as some blast furnace slag and fly ash. Waste oil from rolling operations is mixed with the neutralized pickle liquor at the Brown Disposal Site. Allegheny Ludlum currently disposes of mill scale (15% solids) and steel dusts (50% solids) on-site.

Current Industrial Residue Transportation Practices

Transportation of industrial residues to private disposal sites within the county is currently the responsibility of the individual contract haulers and disposal firms handling the waste. Disposal charges include cost of transport to the site as well as treatment and disposal costs. Some transport to on-site disposal areas of large quantities generated by a single industry (such as slag) is done by rail with the remainder by company-owned trucks. No temporary waste storage sites or waste barging operations have been identified.

Municipal Sludge

A recently completed in-depth study of municipal waste treatment residues in Allegheny County (26) indicated that approximately 3,700 dry tons of sludge are produced monthly (120 dry tons/day) by the 30 wastewater treatment plants in the county with design flows exceeding 0.5 MGD. Information on current sludge treatment and disposal practices is presented for these plants as Table 8. Note that quantities presented in Table 1 are estimates from all sources.

The ALCOSAN treatment plant is by far the largest single sewage treatment sludge generator in the county, producing about 80% of the sewage sludge. The sludge is treated by vacuum dewatering, incineration, and ash disposal in a landfill. Direct hauling of dewatered sludge is also practiced.

According to the data generated in the Allegheny County sewage sludge study (26), vacuum filters are used extensively with 73% of the plants using them to dewater 97% of the sludge generated in the county. The remainder of the plants use drying beds or are installing other dewatering equipment.

TABLE 8. WASTEWATER TREATMENT PLANT SLUDGE INVENTORY FOR ALLEGHENY COUNTY (26)*

FACILITY	LOCATION	PRESENT FLOW MGD	DESIGN FLOW MGD	SLUDGE TREATMENT AND DISPOSAL METHODS	SLUDGE SOLIDS %	PRESENT SLUDGE QUANTITY WET TONS/MO.	DESIGN SLUDGE QUANTITY WET TONS/MO.
Piney Fork SS	Bethel Park	2.7	4.1	AN, VF, LF	20	95	145
Clairton MA	Clairton	2.0	6.0	AN, VF, LF	20	100	630
Coraopolis MSA	Coraopolis	2.0	3.0	AER, VF, LF	20	240	360
Dravosburg SA	Dravosburg	0.3	0.5	EA, DB	40	20	33
Duquesne SA	Duquesne	1.5	2.0	AER, VF, LF	20	200	265
Upper Allegheny JSA	East Deer Twp.	4.0	6.0	AN, VF, LF, LA	20	300	630
Elizabeth MA	Elizabeth	0.6	0.6	AN, VF, LF	20	65	65
Buena Vista STP	Elizabeth Twp.	0.5	0.7	EA (To Elizabeth)	5	200	280
Glassport STP	Glassport	1.0	1.2	AER, DB, LF, LA	40	68	80
Allison Park STP	Hampton Twp.	0.5	1.0	AER, DB, LA	40	18	36
Allegheny Valley JSA	Harmar Twp.	-	3.0	AN, VF, LA	30	-	65
Leetsdale STP	Leetsdale	0.63	0.85	AN, VF, LF, LA	25	20	28
Longvue #1 STP	McCandless Twp.	-	1.6	AER (To Pine Creek)	20	150	150
Pine Creek STP	McCandless Twp.	-	3.0	AER, VF, LF	20	-	315
McKeesport WPCP	McKeesport	-	9.5	VF, IN, LF	30	200	760
Montour Run WPCP	Moon Twp.	1.7	2.5	AER, VF, LF	20	230	340
Oakmont SA	Oakmont	1.2	1.2	AN, VF, LA	20	65	65
Long Road STP	Penn Hills	0.85	1.1	AN, VF, LA	20	90	115
Sandy Creek STP	Penn Hills	1.8	1.8	AN, VF, LA	20	190	190
Gascola STP	Penn Hills	0.8	0.8	AN, VF, LA	20	85	85
Plum Creek STP	Penn Hills	0.85	2.2	AN, VF, LA	20	90	230
Alcosan	Pittsburgh	180	200	VF, IN, LF	20	15,000	16,500
Pleasant Hills MA	Pleasant Hills	2.4	3.0	AN, DB, LF, LA	40	153	190
Holiday Park STP	Plum Boro	-	0.7	EA, VF	20	125	125
Orchard Park STP	Richland Twp.	-	0.6	AER, LF	4	150	150
Campbells Run WPCP	Robinson Twp.	0.3	1.0	AER, DAF, LF	20	30	100
Sewickley Boro STP	Sewickley	0.7	0.9	AN, VF, LF, LA	21	50	65
Chartiers Creek STP	S. Fayette Twp.	0.2	2.4	AER, VF	20	20	240
Thompson Run STP	West Mifflin	1.7	2.5	AN, DB, LA	40	108	158
New England STP	West Mifflin	0.8	1.2	AN, DB, LA	40	50	75

AER = Aerobic Digestion
AN = Anaerobic Digestion
EA = Extended Aeration
VF = Vacuum Filtration

DAF = Dissolved Air Flotation
DB = Drying Bed
IN = Incineration
LA = Land Application
LF = Landfill

*For plants over 0.5 MGD flow

Wastewater treatment sludge hauling, as with industrial residues, is done principally by private companies on a contractual basis. Typically, vacuum tankers are used for liquid sludges and covered dump trucks are used for dewatered material. Where land application of the sludge is practiced, those using the sludge normally provide for its transportation.

Sludge from 14 of the 30 wastewater treatment plants in Table 8 is disposed of by "land application." However, this is not considered equivalent to engineered land application systems that are coming into greater use for the disposal of sewage treatment effluent and wet waste sludge. In general, most small plants typically stockpile sand dried sludge for removal by farmers and home gardeners or spread the sludge at the plant site. The amount of sludge from these plants represents only 6% of the total sludge quantity generated, mainly because of the influence of the ALCOSAN plant. The remaining sludge or ash is ultimately landfilled.

There are currently seven sanitary landfills for sludge disposal in operation in Allegheny County as well as landfill operations located contiguous to the Allegheny County border in Beaver, Butler, and Westmoreland Counties. Most of the sites have useful lives of less than 10 years under current DER permits; however, land is available for expansion at most locations.

Septic Tank Wastes

Vacuum and pumping tank trucks of various sizes are used by nine different private operators to collect septic wastes from residential and commercial systems and dispose of it on land or at wastewater treatment plants. Septic tank pumping activity in Allegheny County is summarized in Table 9. Three of the contractors dispose of sludge in other counties.

Sludge From Water Treatment

The quantity and characteristics of water treatment residue from softening and coagulation processes are a function of raw water quality, the type and amount of chemicals added, and the unit operations used (e.g., coagulation, filtration). Sludge generation from existing individual water treatment plants was estimated using typical values (25).

Water treatment plants have typically discharged the solids removed from water treatment operations to the rivers from which the raw water was withdrawn. However, there is increasing pressure to abandon this approach and develop more environmentally acceptable techniques. Most residues are contained in the underflow from clarifiers and in filter backwash. Backwash wastes are very dilute, with suspended solids contents normally ranging from 0.08 to 0.2%. Clarifier sludge usually is removed at about 1 to 2% solids. Some plants recycle filter backwash water to the head-end of the clarifiers, thus combining the backwash solids with the clarifier sludge. Another technique used is to discharge sludge to a municipal sewer system.

TABLE 9. SEPTIC TANK WASTES INVENTORY (26)

NAME	LOCATION	EQUIPMENT	MATERIAL HAULED	QUANTITY (GAL/WK)	DISPOSAL METHOD
Henry Arch	Oakdale	Vacuum Tanker (3) 200, 400, 600 gal.	Residential Septic Commercial	3,500	Alcosan Moon Twp. STP Mazzaro Landfill
Phillip Brunn Jr., Inc.	Ingomar	Vacuum Tanker (2) 1100, 5000 gal.	Wastewater Sludge Residential Septic	4,000	Land Application (Butler Co.) McCandless STP Ellwood City STP
Long Sanitation Service	Bridgeville	Vacuum Tanker (1) 1250 gal.	Residential Septic Commercial	5,000	Alcosan South Fayette STP
J. J. Nolte	Coraopolis	Vacuum Tanker (1) 2000 gal.	Residential Septic	5,000	-
Vogel Disposal Service, Inc.	Mars	Vacuum Tanker (3) 2000, 2-3000 gal.	Residential Septic Wastewater Sludge Schools County Parks	30,000	Hampton Twp. STP Vogel Landfill
J. Hapchuk	Export	Vacuum Tanker (2) 1000, 1200 gal.	Residential Septic Commercial	2,000	Land Application (Westmoreland Co.)
A. Podobnik	Plum	Vacuum Tanker (1) 1500 gal.	Residential Septic Wastewater Sludge Commercial	20,000	Land Application (Allegheny Co.)
Robert Bongorni	Atlasburg	Vacuum Tanker (1) 1500 gal.	Residential Septic	300	Land Application (Washington Co.)
Bakerstown Sanitation	Gibsonia	Tanker (2) 2-2000 gal.	Residential Septic Wastewater Sludge Commercial	10,000	Land Application (Allegheny Co.)

Investigations into the feasibility of sludge processing and disposal have been made for four water treatment plants (26). Typical approaches for sludge treatment and disposal include lagoons for sludge dewatering, with the removed sludge cake being transported to a sanitary landfill for ultimate disposal. The West Penn-Hays Mine Plant is awaiting State of Pennsylvania approval before initiating a deep mine sludge disposal operation.

Current Residue Disposal Costs

Current residue unit treatment and disposal costs are presented in Table 10. These were derived mainly from data obtained through extensive contacts with industrial and municipal personnel during the study. The unit costs are estimates for given classes of residues. As such, the costs may not be representative of residue disposal cost to a specific industry. In addition, the unit costs may not be comprehensive in accounting for all components of cost (e.g., transportation, amortization, and management). For several industries, costs were only availalbe for the disposal of mixtures of residues. These mixed residue disposal costs are also included in the Table.

Estimates of municipal sewage sludge treated by dewatering, incineration, and landfill operations were extrapolated from unpublished data (26). Unit disposal costs for these wastes were developed from ALCOSAN annual reports. Water treatment sludge unit costs were taken as equal to those for waste treatment sludge.

FUTURE RESIDUE MANAGEMENT PRACTICES

The Clean Water Act requires BPT for industrial wastes at the present time and more stringent treatment techniques to be applied in the 1980's. These treatment requirements will cause increased residue generation for some industries. In addition, the Toxic Substances Control Act and the Resources Conservation and Recovery Act, both passed by Congress in 1976, will require controls on the management, handling and disposal of thousands of industrial chemicals. While final regulations have not yet been promulgated, it is certain that they will significantly impinge on residue disposal practices. At the same time, there is a growing effort by regulatory agencies to ensure that residue disposal will not cause adverse environmental impacts, and thus reduce the effectiveness of comprehensive, expensive municipal and industrial water and air pollution control programs.

Residue generators, therefore, will be faced with dealing with more stringent requirements for residue disposal. In addition, the increasing cost of resources will provide additional incentive for reclamation and reuse.

There are a number of approaches that could be taken to provide effective treatment, disposal and reclamation of residues. One technique, institutional in nature, would be to promulgate and enforce more stringent regulations to protect environmental quality. Also, industries could join in small groups to provide more cost-effective residue disposal or reclamation.

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TABLE 10. CURRENT RESIDUE TREATMENT AND DISPOSAL COSTS

Residue type	Unit disposal cost ($)	Cost includes
Oily wastes (A1-A9)	.00-.06/gal	collection, landfill
Spent solvents (B1-B4)	.08-.25/gal	reclamation, burning
Organics (C1,C5)	6.00/Ton	collection, landfill
Coal fines (C3)	1.00/Ton	disposal to lagoons
Municipal WWT sludge (C4)		
dewatering	7.00/Ton	
incineration	20.00/Ton	
landfill	6.00/Ton	
Iron hydroxide sludge (D1)	.02/gal	hauling, lagooning
Metal finishing residues, (D2) spent pickle liquor	.02-.06/gal	contract hauling, neutralization
Iron hydroxide sludge (D1) and H_2SO_4 pickle liquor (D3)	$.27/gal	landfill
Air pollution residuals, scale (D4-D9)	3.00/Ton	landfill
High-silicon scrubber sludges (D6)	$.03/gal	landfill
Foundry sand (E1)	6.00/Ton	landfill
Slag, steel (E3)	3.00/Ton	landfill
FGD sludge (E4)	6.00/Ton	fixation dewatering landfill
Cement dust, cullet (E5, E6)	3.00/Ton	landfill
Mixed cullet (E5) and air pollution dusts (D5)	$14.40/Ton	landfill

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References: Environmental Quality Systems, Inc., 1977; The Chester Engineers, 1977; and ALCOSAN Annual Reports.

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TABLE 10 (continued)

Residue type	Unit disposal cost ($)	Cost includes
Water treatment sludge (E7)	6.00/Ton	dewater and landfill
Mixed inorganic wastewater treatment sludge (E7) and fly ash (E8)	$11.00/Ton	landfill
Ash (E8)	3.00/Ton	landfill
Miscellaneous chemical wastes (F1-F5)	.08-.16/gal	burning, chemical landfill
Coke product residues (F6-F7)	6.00/Ton	lined landfill
Mixed oily sludge (A1), cullet (E5), air pollution dust (D5), and hazardous inorganics (F5)	$74.90/Ton	containing, hauling, landfilling

Public or private organizations could be established or encouraged to provide more comprehensive services to residue generators. As previously discussed, this study focuses on the identification and preliminary evaluation of centralized physical facilities and management approaches.

This section presents the results of analyses of the future needs of industries, municipalities and other residue generators in relation to a centralized residue management system.

Approach to Future Residue Management

At the present time, residue handling, treatment, disposal and reclamation technology is available to:

1. Reduce the amount of wastes generated.
2. Concentrate waste at the source to reduce handling and transportation costs.
3. Reuse wastes from one facility as raw materials of another.
4. Recapture and recycle metals, energy-containing wastes, and other natural resources contained in residues.
5. Detoxify and/or neutralize wastes destined for land disposal, thereby eliminating or reducing adverse environmental impact.

Due to the range of source types, a wide variety of solid and liquid residues are generated in the county.

As a first step in formulating alternative residue systems, each waste category was analyzed in relation to: characteristics of the residue; current waste disposal practices; other available options for disposal; the perceived adequacy of those operations; potential for reclamation; and known plans for expansion of existing facilities. Existing residue disposal practices were then analyzed in the context of three possible general approaches for process selection as a part of an area-wide residue management system. These three possible approaches are:

1. To continue current practices. This implies that the current approach is considered adequate to meet future conditions.
2. To modify an existing system. Indicating that the existing system may need to be structurally upgraded; non-structural controls may be implemented; or that changes in the existing system should be made to make the system more efficient, cost-effective and environmentally sound.
3. To develop or encourage a new management system. This includes consideration of treatment and handling of the wastes, resource recovery techniques, and new waste disposal options.

Using the criteria of protecting public health, minimizing adverse environmental impact, and conserving natural resources, general goals were established for centralized systems. These include:

1. Making reuse/recycle/resource recovery a primary objective.
2. Emphasizing the "waste exchange" concept, where possible. This concept involves an agency or organization that acts as a "broker" in matching available wastes with potential users of those wastes.
3. Provide for the adequate collection and treatment of all appropriate residues.
4. Reducing incineration to alleviate air pollution episodes in the county.
5. Reducing the quantity of material to be transported to increase cost-effectiveness.
6. Reducing public expense and, where cost-effective, promoting private enterprise.

With the implementation of more advanced wastewater treatment technologies, total residue quantities for most categories are expected to increase. In estimating the maximum possible residue quantity the implementation of zero discharge (of pollutants) treatment technology was considered. Industrial expansion is another factor which could increase estimates of future residue quantities. Expansion factors obtained from previous industrial surveys were utilized in projecting the 1985 maximum expected quantities utilized in the preliminary design and costing of the residue management plan.

In some instances, however, the unit quantity of residue per generating activity may actually decrease due to improved plant efficiencies or recycle/reuse. Currently, blast furnace dust, mill scale, coke breeze, sinter dust, kiln dust, and coal fines have significantly high in-plant recycle/reclamation rates. As another example, if the cost for residue handling and disposal cost increases appreciably, in-plant efforts to reduce residue production become more attractive.

Disposition of Residues

Each of the subcategories presented in Table 1 was analyzed individually as to whether it would be a candidate for inclusion in a centralized system. A waste subcategory was determined to be adequately handled at the present time if: (1) most of the material is being disposed of to a landfill with a DER permit and no option of recycling or recovery system appears feasible; (2) most of the material is being reprocessed for reuse; (3) most of the material is being recovered for some other purpose; or (4) the residue was judged to be best handled by the present method, or an upgraded version of the present method.

The following considerations were used to evaluate the adequacy or inadequacy of current disposal practices:

1. Adverse environmental impact.
2. Conservation of natural resources and energy.
3. Reuse and recycling of materials.
4. Quantity of materials being handled.
5. Quantity of material currently being incinerated (incineration was considered to be the least acceptable alternative).

6. State of the art of treatment, disposal, and/or recovery technology.
7. Total quantity of material to be hauled.

Current disposal practices are considered to be adequate for five subcategories of residues (see Table 1). These five subcategories are:

1. Coal fines (C3) from coal washeries and other handling operations are currently being lagooned and the quantities may be considered as a stockpile for future use.

2. Scale (D7) from rolling and milling operations is being placed in lagooned areas. Some quantities are being recycled and the remainder may be considered stockpiles for potential future reclamation. The quantities of scale presented in this report are those which are currently not being settled in scale pits and resintered at the steel mills. These quantities could be hauled to landfills or to reclaiming operations at other steel plants. The costs presented herein are for hauling and landfilling, but this alternative should be reexamined in the preliminary design stage.

3. Most of the iron slag (E2) being produced, and a very small fraction of the iron slag which has been piled on open dumps in the past, probably less than 5%, is currently being recovered by crushing and demetallizing for recovery of the iron value with use of the resulting gravel as a construction material.

4. Sludges resulting from liquid scrubbers at air pollution control facilities (D6) and flue gas desulfurization sludges (E4) are currently being landfilled and/or disposed of in lagoons which possess Pennsylvania DER permits.

5. Dusts from air pollution control facilities (D5), (e.g., baghouses), and from foundry operations (D8) most of which contain heavy metals are currently being landfilled at power plant or company-owned facilities which possess DER permits.

A number of residue subcategories are being managed in ways which are felt to be adequate at the present time but could need improvement in the future.

1. Steel slag (E3) is apparently not as readily amenable to crushing and demetallizing as is iron slag. Currently, steel slag is being piled in open dumps. This operation could be improved by covering with earth and planting, followed by use of the resulting land area for other purposes. The structural characteristics of the existing piles must be examined if subsequent use of the surface is intended. Future technological advances may favor reclamation of steel slag.

2. Cullet from glass manufacturing (E5), dust from cement plants (E6), and fly ash (E8) currently being landfilled are amenable to sintering and production of building materials, bricks and building blocks. Such technology has been demonstrated, and is currently in use on a limited scale. To use all of these residues generated in Allegheny County for this purpose, however, would result in 10 to 15% of the total U.S. brick production; therefore, this is not considered a viable alternative to current landfilling operations by residue generators. A building materials production operation using a portion of the generated residues could perhaps be initiated with the potential for growth in the future.

The remaining materials were judged to require improved disposal techniques. The selection of a particular technique for a given subcategory was based on an evaluation of alternative approaches.

1. Oily wastewater treatment plant skimmings (A1) are residues collected separately from other sludges at industrial wastewater treatment plants. These materials may be collected by tank truck and disposed of at centrally managed landfills.

2. Waste oils (A2-A6, A8)may be handled in a number of different ways. Alternatives examined included: direct incineration with fuel oil at fuel oil burning facilities - rejected because of heavy metal content; leaving the existing situation as is - rejected because there is a high likelihood that a significant quantity of waste oil is being disposed of to sewers, area streams and surface waters or to the ground with subsequent possible groundwater contamination; reclamation and reuse in specially designed and constructed facilities --the alternative selected. Although waste oil scavengers were identified during the source of this effort, information was not available on the quantity of material being refined. Even though the quantities of waste oil expected to be recovered is only a small fraction of the total lubricating and fuel oil used (probably a few percent), the quantities may represent a significant fraction of any shortages which are likely to occur in the future (also on the order of a few percent).

3. Waste oil tank bottoms from storage facilities (A7) are currently being lagooned and could potentially contaminate groundwater. These "sludge-like" materials are not suitable for reclamation in the waste oil recovery facility and are very difficult, if not impossible, to dewater. They could be incinerated in a specially-prepared incineration facility.

4. Waste solvents (B1-B4) are being reclaimed to a significant extent in a specially designed facility at the Pittsburgh Plate Glass Co. (PPG). It is likely that the remaining solvents being generated would not be amenable to recovery at the same PPG facility. Many solvents have a high recovery value and a solvent recovery facility

based on distillation has, therefore, been included in the proposed management system.

5. Several alternatives exist for organic sludges from industrial sources (C1) and sludges from municipal wastewater treatment facilities (C4). Disposal together with ALCOSAN sludges was considered. This alternative involved additional incineration which was considered to be the least acceptable alternative. Land disposal of wastewater treatment sludge is an attractive ultimate disposal technique. There are a number of different application alternatives as well as options for cropping techniques. The application rate is the primary factor in the rational design of land disposal facilities. The selection of effective application rates is highly site specific, depending on sludge characteristics (nutrient and metal content) and land characteristics. Because the application rates determine the land requirements, the major cost element in the system, complete design and cost estimation for a representative system was considered beyond the scope of this project. Composting with landfill was selected for the centralized system and generalized cost estimates are presented. Septage (C4) quantities collected from individual homes were included. Because of its relatively small volume, cleaning emulsions (C5) were also included. This alternative and direct land application should be evaluated in depth in the next phase.

6. Hydroxide sludges are generated from the treatment of pickle liquor (D1). Chemical sludges from the steel industry are expected to increase over existing quantities because of the Pennsylvania regulatory requirement to treat acid rinse waters as well as pickle liquor discharges. Production of sludges from the pickle liquor portion can be eliminated if pickle liquor is reclaimed rather than treated on an "end of pipe" basis. Recovery of pickle liquor must be evaluated by the individual steel companies, and the cost for process modification should be evaluated against the costs for neutralization and disposal of sludges to landfill, which is included as a part of a centralized system.

7. Metal finishing sludges (D2) are generated by a number of small platers in the area; however, the majority of these residues are generated by the steel companies that do metal finishing as a part of their overall operation. Metal finishing sludges may be expected to increase as federal and state pretreatment regulations are put into effect over the next several years. Some potential exists for recovering the heavy metal values from these chemical sludges. In each case, however, the potential for in-plant process changes, such as installation of counter-current rinsing or complete reclamation of plating baths, should be examined on an individual plant basis. The costs for making process changes should be evaluated against the costs for treatment and disposal of chemical sludges. A process for recovery from sludge of certain metal values (copper, nickel and chromium) by leaching and electro-winning

appears to be technically feasible but is only in the developmental stage. For this initial analysis, however, disposal to a carefully controlled chemical waste landfill has been adopted.

8. A certain portion of the spent sulfuric acid pickle liquor (D3) generated at the present time is hauled away by scavengers. EPA has specified BPT requirements for continuous pickling operations as either neutralization or acid recovery (28). The latter operation requires in-process changes to result in higher acid concentration in the waste pickling baths. The potential recovery products are sulfuric acid and ferrous sulfate, copperas, which could have a market in other industries. Because of the uncertain economics, lack of widespread applications and need for in-process changes, neutralization has been selected for incorporation into the central system. Typically, waste sulfuric acid pickle liquor is neutralized with lime, producing voluminous sludge which is difficult to dewater (about 2 lbs. sludge/lb. acid). For initial design purposes, the waste sulfuric acid pickle liquor would be collected by tank truck and neutralized. The resultant sludge would be disposed of in sanitary landfills along with hydroxide sludges (D1). The question of possibly adopting acid recovery techniques should be periodically reviewed as the technology and economics of this approach become more defined.

9. Air pollution dust (D5) and mill scale (D7) could be analyzed for feasibility of applying electromagnetic metal separation at a later stage in the development of the management system.

10. About 20% of the waste foundry sand (E1) is currently being reclaimed. The separation of oil and additives from foundry sand can be accomplished by a sand "washing" process that yields a reusable product. Costs are presented later for a mobile reclamation module which would move from site to site so that sand hauling costs are not incurred.

11. Depositing steel slag (E3) in open dumps exposes the residues to rainfall and promotes subsequent leaching to the surface and groundwaters; it is not considered an adequate approach. The cost of hauling these vast quantities to other sites would be prohibitive. Steel slag is not considered to be usable for highway construction as is iron slag. The piles could be covered with earth and the surface vegetated as an interim alternative while recovery of metal value is being researched. Costs are not included for this option.

12. The relatively small quantities of caustics (F2) generated may be neutralized with waste acids (F1 or D3) followed by sludge landfill. This has been included.

13. Incineration appeared to be the only feasible approach for tank bottoms (A7), organics (F3), waste paints and dyes (F4) and pitch,

sand and tar (F7). These materials are essentially organic in nature and can contain materials which require special precautions during disposal.

14. Certain wastes from railroad equipment manufacturing and waste paint product residues (F5) could be collected and encapsulated in a special way to prevent environmental contamination.

15. Sludges from biological treatment of coke plant wastes (F6) may contain heavy metals and organics and could be carefully landfilled rather than disposed of through the composting operations for other industrial organic sludges and municipal wastewater treatment sludge.

16. Significant quantities of water treatment sludge (E7) are produced. This material is essentially inorganic in nature, consisting of settleable and filterable solids removed from raw waters and precipitated coagulants (usually aluminum hydroxide). Plants that practice softening generate softening sludge, primarily magnesium hydroxide and calcium carbonate, depending on the process used. The dilute residues from water treatment plants are considered less objectionable than sewage sludge. Until recently, the common practice was to discharge backwash and coagulation residues to the nearest receiving water. A currently accepted disposal method would include dewatering and landfill. If the residue is to be transported to a central site by trucks, dewatering before transport becomes an important consideration. Technology for water treatment residue dewatering is not well defined. One study (29) indicated that pressure filtration or scroll centrifugation dewatering might be feasible as a means of increasing solids contents to about 20%. Filtration was found to have the lowest unit cost for dewatering.

Modular Systems

Where possible, modular systems were employed in the initial design of centralized systems. A modular system is one that is designed in standard replicable units. The units can be joined in parallel to provide greater processing capacity as needed, in a building block fashion. Modular systems can be designed and installed for treatment, reclamation or disposal of residues, with a possible ability for expansion as the need expands. Relative residue quantities for a particular industrial sector may change because of different BPT and BAT requirements. Therefore, the amount and type of residues may change significantly with time.

The "module method" for waste and residue treatment has several advantages, including:

1. easy expansion of system capacity,

2. minimal "overdesigning," therefore less time where the facility is "under-utilized,"

3. possible placement of several modules in different locations thus providing flexibility.

A disadvantage of modular systems is potential loss of economies of scale at full capacity. Where possible, unit process modules were employed for residue treatment, based on some fraction of expected BAT residue quantities.

The "Waste Exchange"

A concept that may be applicable is that of a waste exchange, which is essentially an institution through which the waste from one industry may find a potential market as raw materials with another industry. This extends the reuse/recycle approach beyond the individual industry to a region or even nationally. During the past four years, waste exchanges have been established in over ten European countries (30, 31). Two waste exchange clearinghouses have recently been established in the U.S.; both operations are similar to those in Europe (See Table 11).

The first U.S. clearinghouse was established in St. Louis in October 1975 (32). Waste producers and waste users maintain contact through the clearinghouse. Approximately 50% of the material offered for exchange has found a market (33). Although approximately 89% of the materials (over three million tons) listed as available was dilute sulfuric acid (January 1976 listing), other materials traded in the exchange have been inorganic chemicals, solvents, copper, coal tar, baghouse dust, waste oil, and lime slurry. Some materials such as wastewater sludge, tank bottoms and fly ash are very difficult to dispose of by the waste exchange method.

In Iowa, the Industrial Waste Information Exchange was founded in April 1976 and is conducted by the Center for Industrial Research and Service (CIRAS) at Iowa State University. In their first listing (30), available materials included waste oils, wood products, and paper products.

Two cities, Atlanta and Houston, have recently begun waste exchange operations (34). At the time of this report, pertinent information about these exchanges was not available.

Clearinghouses in Europe also divert residue materials to centralized reclamation treatment and disposal facilities. In Denmark, the Nordic Waste Exchange facility handles waste oils, solvents, organic chemical wastes, halogen-containing debris, inorganic chemical wastes, soil, sand, and old packing materials (31). The system uses approximately 25 large collection points, including rail transportation, for receiving hazardous liquids in tanks or sealed in drums. These central points are no more than 30 miles apart. At least one pickup station is established within each municipality. Processes at the plant include specialized waste incineration, distillation of solvents, and hydrochloric acid regeneration, which can produce ferric

TABLE 11. WASTE EXCHANGE CLEARINGHOUSES IN THE U.S. AND EUROPE*

Country	Name of clearinghouse	Date established
Netherlands	Association of Dutch Chemical Industries	1972
Belgium	Belgium Chemical Industry Association	1972
West Germany	Chemical Industry Association	1972
Austria	(Joined West Germany's Association)	1972
Switzerland	Swiss Society for the Chemical Industry; Association of Swiss Paint and Varnish Manufacturers; Union of Soap and Detergent Manufacturers	1973
Denmark	Nordic Waste Exchange (Nordic Intergovernmental Foundation)	1973
Norway	" " " "	
Sweden	" " " "	
Finland	" " " "	
United Kingdom	Department of the Environment Waste Exchange Clearinghouse	1974
U.S./Missouri	St. Louis Waste Exchange	1976
U.S./Iowa	Iowa Industrial Waste Information Exchange	1976

*Other operations than those listed here are probably in operation within the recent past.

oxide in granular form. The plant is reported to be having economic problems because revenues appear to be insufficient to cover the actual operational costs of the facility.

Another facility in Germany combines industrial waste with municipal waste for treatment (35). Industries in the area may transport the residual materials to the facility, which receives all materials including toxic substances such as arsenic, cyanide, and a few chlorinated hydrocarbons. Pesticides are stored for future disposal. The plant is essentially a detoxification plant. A fee is collected depending upon the amount of treatment needed and the quantity of the waste.

A recent study on waste exchange concepts indicated that a hierarchy of industries usually are involved (36). Industries requiring high quality raw materials tend to sell their wastes to industries with lower quality standards. Therefore, if a diversity of such industries is available, an exchange may be feasible. The same study recommended that governmental agencies should not operate waste exchanges because of their regulatory function and problems associated with the confidentiality of waste stream constituents. Currently-existing waste exchanges in the U.S. are not government operated. The waste exchange may be started as a first step while final planning of an area-wide program is underway. The feasibility of the exchange will develop if the sources and buyers exist.

Waste exchanges are recommended for detailed consideration in residue management programs in the county. It is not possible at this time, however, to estimate the types or amounts of residues that could be successfully "exchanged." In the alternatives developed later, provisions are made for staffing a waste exchange. A more detailed analysis of potential "customers" is recommended as an overall residue management program progresses toward implementation.

SECTION 6

COLLECTION AND TRANSPORT OF RESIDUES

TRANSPORTATION ALTERNATIVES

In an areawide management system, several alternatives exist for moving wastes to a centralized treatment and disposal site:

1. Barge transport - might be effective for generators located on the three major rivers. Typical barge sizes of 3000 to 6000 tons would only be filled with any reasonable frequency by the largest residue generators. Barging is most attractive when long distances are involved since loading and unloading greatly influence unit transportation costs. Therefore, this approach was not considered for application in this study.

2. Rail transport - is similar to barging in that a suitable rail network must be available and that unit costs are significantly influenced by the distance traveled. While rail transport was not considered further in this study, closer examination of individual industries in relation to specific disposal sites might yield favorable results.

3. Pipelines - have been successfully used to transport liquids and slurries for comparatively long distances. Due to the need for waste segregation, pipelines would have to be dedicated to industries generating similar residues. Pipelines typically handle large amounts of materials; therefore, the use of this approach would be limited to the larger residue generators. Because the economics of pipeline disposal are highly site-specific, this approach was not considered further at this stage of planning.

4. Truck transport - has the advantage of being applicable to all residue generators. Also, specifically designed trucks may be selected to handle specific residues such as liquids or slurries. Truck transport represents the most flexible approach in that if trucks are leased, little or no capital investment is required in fixed facilities (e.g., rails, barges or pipes). Thus, the number of trucks could be increased or decreased, depending upon specific needs. For these reasons, truck transport was used in the development of transportation cost estimates.

Truck transport could be provided by a centralized management system or by the residue generators. The latter approach would not be cost effective for the smaller residue generators for whom company-owned equipment might be idle much of the time, thus increasing unit costs. For the purposes of this study, it was assumed that trucks would be leased and operated by a central agency. A more detailed investigation would be required to evaluate the relative attractiveness of truck purchase.

For sludges with a high moisture content, such as iron hydroxides and metal finishing wastes, dewatering at the site before transfer would reduce transportation costs. On the other hand, dewatering at a central facility could result in economy of scale benefits related to dewatering equipment. The tradeoffs between dewatering (whether at the residue generation site or at a central facility) and the costs of transportation, treatment and disposal should be performed in more detailed studies.

Transportation costs are sensitive to a number of parameters and, because of hauling distance, are particularly sensitive to pickup and delivery location. There are many potential sites in the county which would be suitable for landfill, chemical waste landfill, processing, and storage facilities, including capacity expansion at existing sites. A "centralized" residue management system does not necessarily mean that all functions would be handled at one location. Due to a concentration of a particular type of residue generators, a specific facility might be located remotely from the main centralized processing and treatment location.

A complete analysis of transportation costs would require detailed knowledge of the locations of all residue generators in a central system as well as the specific sites and functions of all treatment, disposal and reclamation facilities. This was beyond the scope of this study; however, this analysis should be performed early in the facilities design stages.

In this study, a computer model was used to develop transportation costs for wastes trucked to central facilities in Allegheny County. A number of disposal sites were investigated as was the sensitivity of transportation costs to parameters such as truck costs, route, labor cost, truck size and truck utilization. The model was developed during a previous study and is described elsewhere (37). Modifications were made to accommodate certain study aspects and to alter such things as format and input/output.

As expected, compilation of residue amounts by collection districts in the county show major concentrations in the heavy industrial districts, primarily the Monongahela River Valley. A detailed listing of residue quantities by collection districts is given in Appendix F. A number of sites were selected arbitrarily to use in the model and to determine the variability of results to changes in the transport parameters. These sites are not necessarily sites which would be selected for implementation. Three sites near the Monongahela industrial district, in Forward Township, South Park Township, and Monroeville Borough, were evaluated. In addition, two other sites in Kennedy and Findlay Townships were chosen. The Forward Township site was modeled on a "good," "average," and "worst" case basis to illustrate the range in transport costs which can be expected in response to a number of variables listed in Table 12. It was felt that this approach would yield a wide range in results but the range limits would probably

TABLE 12. TRANSPORT VARIABLES

	CASE		
Parameter	Good	Average	Worst
Truck lease charge ($ per year)	8200	8700	9200
Lease cost/mile ($)	.11	.12	.13
Overhead factor	.25	.50	1.00
Circuitry factor* (a)	1.06	1.3	1.4
Truck capacity (liters)	22,700	20,800	10,600
Circuitry factor* (b)	1.06	1.2	1.3
Utilization factor	0.50	0.36	0.22
Overflow factor	1.00	0.87	0.67
Av. travel speed during collection(MPH)	25	15	10
Av. speed return to plant	30	22	15
Loading rate (liter per hour)	31,800	27,250	22,500
Waiting time in region (hr.)	.08	.17	.25
Waiting time at plant (hr.)	.05	.10	.20
Drivers per truck	1.0	1.0	1.25
Driver labor rate ($ per hour)	6.00	7.00	9.88
Support workers per truck	0	0	.25
Support worker labor rate ($)	--	--	5.81
Truck insurance ($)	1400	1440	1500

*To account for trucks travelling over roads rather than in a straight line.

contain the best estimate of equipment, personnel needs, and costs. The parameter values are based on data existing in Allegheny County in early 1977 and are subject to significant variability, particularly labor rates.

Many of the factors are self-explanatory. The circuitry factors take into account the trucks traveling over various routes to reach the disposal and treatment sites. The "a" circuitry factor reflects route variations during collection and the "b" factor variations on the return trip when filled. Depending on the season, industry production rates and other considerations, the utilization factor of trucks will vary. Trucks standing idle will affect cost since lease rates are paid on a time basis. The overflow factor reflects trucks returning partially filled because of collection load quantities or other reasons. The next pickup on a route may exceed remaining capacity, return distance may be shorter than that to the last pickup and it may be late in the day, etc. Although the basis of the analysis is one shift (8 hours) it may be necessary in peak periods or during "catch-up" times to add additional drivers, thus the variation in "drivers per truck." Support workers to assist the drivers may be required in certain complex loading/unloading operations, and/or to reduce loading or unloading time.

RESULTS

Equipment Needs

A summarization of the number of trucks needed and total costs by residue classification for each of six cases examined is presented in Table 13. The three cases for the Forward Township site indicate that transport costs can vary from less than half to over five times the average cost dependent upon truck size, labor rates, utilization of equipment, and other factors.

Varying the location of the treatment facility within the county significantly affects equipment requirements and costs, since total yearly transportation cost to the Findlay Township site is projected at approximately $2 million more than the most economic site in South Park Township (4.7 to 6.7 million). Any potential savings in land acquisition costs, for example, at one site could therefore be quickly lost to higher transportation costs.

The personnel needs for the examples presented are as follows:

Plant Location	Case	Drivers	Support Workers
Forward	Good	36	0
Forward	Average	78	0
Forward	Worst	521	104
South Park	Average	73	0
Kennedy	Average	79	0
Findlay	Average	98	0
Monroeville	Average	80	0

TABLE 13. PROJECTED TRANSPORTATION NEEDS AND COSTS

Plant location	Forward			Forward			Forward		
Case:	Good			Average			Worst		
Residue Class	T	¢	T_C	T	¢	T_C	T	¢	T_C
Oil (A1-A7)	.7	.21	48	1.5	.46	103	7.5	2.8	617
Oil + Crankcase (A1-A8)	1.3	.23	87	2.9	.53	197	13.3	3.0	1100
Solvents (B1-B4)	.4	.66	27	.9	1.5	60	4.4	8.9	364
Pickle Liquor (D3)+Fe $(OH)_3$ (D1)	16.9	.22	1120	37.3	.49	2560	201	3.2	16300
Metal Finishing (D2)	1.2	.25	83	2.7	.57	189	14.7	3.7	1220
Hazardous Wastes (F1-F7)	1.6	.21	106	3.3	.44	228	16.9	2.7	1403
Foundry Sand + APC Dusts (D8,E1)	1.5	.24	108	3.2	.53	224	16.9	3.3	1406
Metallic Solids (D5-D7)	12.7	.22	842	26.6	.47	1830	142	3.0	11800
TOTALS	36.3		2421	78.4		5391	417.7		34210

(continued)

T - Number of Trucks

¢ - Cents per liter or kg

T_C - Total Cost $ x 1000

TABLE 13 (continued)

Plant location	Kennedy			Findlay			Monroeville		
Case:	Average			Average			Average		
Residue Class	T	¢	T_C	T	¢	T_C	T	¢	T_C
Oil (A1-A7)	1.6	.48	107	2.0	.63	141	1.4	.43	96
Oil + Crankcase (A1-A8)	2.8	.51	188	3.5	.65	241	2.7	.50	185
Solvents (B1-B4)	.7	1.1	45	.9	1.5	62	.7	1.2	50
Pickle Liquor (D3)+Fe $(OH)_3$ (D1)	40.2	.54	2790	48.1	.61	3150	40.4	.54	2790
Metal Finishing (D2)	2.5	.52	171	3.0	.62	206	2.8	.58	193
Hazardous Wastes (F1-F7)	3.3	.44	228	4.4	.60	309	3.2	.43	220
Foundry Sand + APC Dusts (D8,E1)	2.6	.41	174	3.4	.57	239	2.9	.48	202
Metallic Solids (D5-D7)	25.9	.46	1780	33.5	.60	2340	25.7	.45	1760
TOTALS	79.1		5483	97.9		6688	79.8		5496

T - Number of Trucks

¢ - Cents per liter or kg

T_C - Total Cost $ x 1000

Costs

Among the examples the South Park Landfill site is best suited for a treatment facility location. Using the "average" case, approximately one million dollars would be saved in yearly transportation costs over the Forward and Kennedy Township sites. Quantities used to develop the costs in Table 11 include metal-containing solids. Excluding metallic solids, transport of remaining residues to be handled would require a fleet of 49 trucks at an annual cost of approximately $3.3 million. The additional collection of crankcase oil from approximately 600 gas stations did not significantly raise collection and transport costs in the waste oil classification (from 42¢ to 48¢ per liter); therefore, collection of waste oil from these additional sources could improve the economy-of-scale for an oil reclamation facility. The collection costs for spent solvents is considerably higher than other residues (1.3¢/liter) due to small volumes; however, recovery values may be high.

The three possible plant locations near the Monongahela industrial district are comparable in transportation costs, differing by approximately 8% from lowest (South Park) to highest (Forward). The Monroeville site is the least cost alternative from the point of view of transportation of all classes of residue except pickle liquor and metallic solids. If pickle liquor is to be treated at a separate site and metallic solids are not handled, Monroeville thus becomes the most cost-effective site; however, land costs may be higher and must be considered.

These examples are presented to illustrate the sensitivity of the model. The cost estimates derived for the three alternatives presented in this report were developed in a similar way and are presented in the next section. The estimates were derived using the South Park location and "average" conditions. Again, an actual site for program implementation could be chosen elsewhere.

SECTION 7

ALTERNATIVES FOR TREATMENT AND DISPOSAL

DESCRIPTION OF ALTERNATIVES

Handling, treatment and disposal of residues often constitutes the most costly single phase of water quality management programs. In the county the types and quantities of residues are expected to constitute a more significant problem than in most other metropolitan areas because of the large and complex industrial mix. Twenty-seven major industries are located along the Ohio River between Pittsburgh and the Pennsylvania-Ohio line. The Monongahela River Basin supports the largest concentration of steel-making capacity in the United States. About 2,000 industries are located in the southwestern Pennsylvania region. These industries are diverse in nature, and the residues produced now and those likely to be produced in the future as a result of implementation of new laws and regulations will continue to constitute a problem for industry.

Residue handling, treatment and disposal will be under increasing control of regulatory authorities. These factors, along with increased economic pressures for resource recovery, strongly suggest the need for new approaches to solve the problem.

At present, residue disposal or reclamation is managed, for the most part, by the individual residue generators. There are a number of general approaches that might be more cost-effective for the residue generators and provide for a higher level of environmental quality control. A number of potential general alternatives were discussed earlier in this report. Most were institutionalized in nature. This section focuses on the examination of centralized physical systems.

The development of residue management systems in the county is a complex problem because of the large number of potential contributors and the variety of available physical systems for handling, disposal and/or reclamation. There is considerable uncertainty as to the type, amount, location and characteristics of residues. For most residue generators, there is little incentive to accurately define residue production because: (1) residues are not in the "main stream" of their activities; (2) accurate data have not been required by regulatory agencies; and (3) accurate data are not required for most current disposal techniques.

The alternatives developed herein are based on the best available data. Over 100 of the major industries were contacted to provide data for this study. The data collected included residue quantities, costs in some cases, and disposal practices.

Unit cost data have also been generalized from available experience elsewhere. These data are referenced, where appropriate, in the text of this section. Land costs are not included. Because of the degree of accuracy of the cost estimates developed (±25%), this study is limited to determining initial feasibility of alternative plans for centralized management. Cost estimates are satisfactory for these purposes because comparisons of alternatives are being made. A more detailed analysis of residue generation rates, residue characteristics and process alternatives is required before design of facilities commences.

General System Design

Based on the discussion in the Future Residue Disposal Practices Section, the following waste categories were identified for inclusion in a centralized system (See Table 1):

A1	Oily Industrial Wastewater Treatment Sludge
A2-A6, A8	Waste Oil
A7	Tank Bottoms
B1-B4	Waste Solvents
C1	Food Processing
C4	Municipal Wastewater Treatment, Septage
C5	Cleaning Emulsions
D1	Iron Hydroxide
D2	Metal Finishing Sludges
D3	Sulfuric Acid Pickle Liquor
D7	Scale
E1	Foundry Sand
F1	Acids
F2	Caustics
F3	Organics
F4	Waste Paint; Dye
F5	Inorganics
F6	Coke Production
F7	Pitch, Sand, Tar

The major elements of a centralized management system are:

- Transportation
- Treatment/Disposal/Reclamation Facilities
- Administration

Treatment/Disposal/Reclamation facilities that were identified earlier for inclusion in a centralized system include:

Neutralization
Encapsulation
Incineration
Sanitary landfill
Special chemical waste landfill (special monitoring and lining)
Composting/landfill
Waste oil reclamation
Solvent recovery
Foundry sand reclamation

A number of residues, including sulfuric acid pickle liquor (D3), metal containing sludge (D2), steel slag (E4) and others, could be candidates for reclamation in the future if suitable technology is developed and proven cost effective. For the purpose of developing the initial program, however, conventional disposal approaches are suggested.

Quantity estimates were developed from available data for industrial residue generation under current conditions as well as the imposition of BPT and BAT waste treatment requirements. Sewage sludge estimates were similarly prepared for current conditions, provision of secondary biological treatment and BPT for all publicly-owned treatment works (POTW). For the purposes of this study, industrial BAT residue generation and BPT for POTW were used as the bases of the initial design of the alternatives.

Modular systems consistent with good engineering design were used, where possible, for facility design. This approach was chosen mainly to overcome uncertainties in future residue generation rates and to minimize capital costs at the start of the project. In some cases, modules were selected with capacities less than the projected BAT requirements. This was done (1) because lesser amounts would be generated before BAT requirements are imposed (additional modules can be added as required) and (2) to account for uncertainties in residue production generation.

Alternative Systems

Three alternatives to continuation of the current dispersed approach to residue management for the county were investigated:

Initial Program--(Alternative A)--

The initial program was structured to proceed immediately without waiting for the development of new technology but taking into account the need to "stockpile" materials with a view to later reclamation/recovery/reuse. The initial program will encompass those types and quantities of residues which cause disposal problems for both large and small industries and municipal facilities - water and sewage treatment plants.

Later Program--(Alternative B)--

The later program was developed to take advantage of expected potential technology developments and to handle larger quantities and more types of residues at a future time when technology and costs are likely to result in a more favorable feasibility determination. The later program includes the initial program and may be considered complete since the remaining residues are adequately handled and/or are being stockpiled, e.g., coal fines.

Limited Program--(Alternative C)--

This alternative excludes most steel company wastes, municipal water and wastewater treatment sludges. Alternative C should meet the needs of small industries if other management alternatives are available for implementation to handle the residues not included.

The development of each alternative is divided into three major categories--transportation; treatment, reclamation and/or disposal; and administration.

In developing the costs for the many individual elements which make up the total systems, potential economic benefits, such as revenues from the sale of recovered metals, solvents, or oil values, were not considered in evaluating alternatives because of the highly variable markets. Therefore, reclamation/recycling is considered as a positive goal from the point of view of both general resource conservation and environmental protection. This is, of course, a conservative view point in that some revenue from the sale of reclaimed material will be generated. Estimates of the maximum recovered value have been made for comparison purposes and are included in the tables as the difference between annual cost and recovered value, and are presented as the "net annual cost."

It should be kept in mind that many combinations other than those presented as the A, B, C alternatives are possible. Waste oil recovery may be implemented as a separate program as indeed, any of the recovery programs may be. A waste exchange together with limited landfill may be the first step to a larger program. An incinerator for difficult to dispose of materials could be implemented separately. A variety of other options are possible. Total capital and annual costs would vary with each and the impact of limited programs on the total county residue picture would be different. The unit disposal costs would vary also--generally lower for options with higher quantities disposed of. The alternatives presented have been developed to illustrate the cost variations and serve as a basis for proceeding with more detailed analysis, and finally design and implementation.

Options and Impacts

In developing the alternatives an analysis of the various disposal options available, and the environmental impacts was made. These considerations are summarized on Table 14. The considerations led to selection of the options presented in the alternatives. Many treatment process and disposal options were examined which were not selected for inclusion in the

TABLE 14. COMPARISON OF ALTERNATIVE DISPOSAL OPTIONS AND IMPACTS

Waste Type Oily Wastes (A1-A8)

Alternative	Advantages	Disadvantages
1. Reclaim oily wastes	1. Potential to reduce oil shortages 2. Environmental contamination eliminated 3. Costs may be recovered	1. Capital investment - operating costs incurred for long periods 2. Need to transport to central locations 3. Disposal of residues from plant 4. Complete collection difficult to obtain
2. Put oily wastes in holding tanks and find a buyer through a waste exchange	1. Cheaper than above 2. No residues disposal required 3. No new construction 4. Management system more straightforward	1. Buyer not likely - high transport costs 2. Significant storage required 3. Costs for storage - little potential return 4. Not a long-term solution
3. Lagoon in lined ponds	1. Cheaper than No. 1 2. Easier to manage than either of above	1. Potential contamination of soil and groundwater 2. Not a long-term solution

(continued)

TABLE 14 (continued)

Waste Type Waste Solvents (B1-B4)

Alternative	Advantages	Disadvantages
1. Continue current practice of disposal-dumping and burning	1. No management required	1. High levels of environmental contamination 2. High recovery value lost
2. Recover solvent at a new facility	1. Capacity chosen to handle study area quantities 2. Recovery value returned 3. Environmental quality control achieved 4. Possible to design for range of input types 5. Independence from other owner/operators	1. More costly than #1 or #3 2. Operation required - operating costs 3. Capital costs 4. Resale required to other solvent users 5. Management is complex
3. Transport to existing solvent recovery via waste exchange	1. No new construction 2. Management simpler than #2	1. Existing capacity limited 2. Input type limited 3. At convenience of existing owner/operator 4. Transportation costs

(continued)

TABLE 14 (continued)

Waste Type Municipal Wastewater Treatment (C4) Sludges

Alternative	Advantages	Disadvantages
1. Handle with existing facilities	1. Organic sludge compatible 2. Management simple 3. Quantities can be handled	1. Haul distances 2. Incineration - potential air contamination 3. Inorganic sludges incompatible unless existing systems revised
2. Transport organic sludge, and recover and/or landfill hydroxide or alum sludge	1. Handles both organic and inorganic 2. Environmental contamination eliminated 3. High level of monitoring and control possible	1. Higher cost than #1 2. Haul distances 3. Air pollution 4. Management complex
3. Landfill on-site or continue current practice	1. Less costly than #1 or #2 2. Little or no hauling	1. Current practice often results in environmental contamination 2. No way to monitor if sludges are being properly managed 3. Contamination of soil and groundwater

(continued)

TABLE 14 (continued)

Waste Type Spent Sulfuric Acid Pickle Liquor (D3)

Alternative	Advantages	Disadvantages
1. Reclaim sulfuric acid pickle liquor	1. No hydroxide sludge production 2. Value reclaimed (acid) 3. Sludge disposal cost minimal 4. Iron sulfate recovered	1. Requires process changes in-plant 2. Investment required 3. Management of sources required
2. Mix a portion with caustic wastes (F2) and reclaim the rest	1. Handles 2 problems 2. Environmental contamination eliminated 3. Reclaim value 4. See #1 above	1. See #1 above
3. Continue current waste treatment practice of neutralization	1. No in-plant changes 2. No new construction costs 3. Familiarity 4. Available now	1. Sludge production, disposal costs 2. Environmental contamination 3. Difficult to monitor 4. Difficult to control many operations

(continued)

TABLE 14 (continued)

Waste Type Organics (C1, C5)

Alternative	Advantages	Disadvantages
1. Handle with WWT sludge at existing facilities	1. Low cost 2. Compatible with existing options 3. Management simple 4. Small quantities handled in already existing systems 5. No new construction	1. Long haul distances 2. Incineration - potential air contamination
2. Landfill	1. Shorter distances to selected landfills 2. Simple institutionally	1. High cost relative to #1 2. Environmental contamination

(continued)

TABLE 14 (continued)

Waste Type Foundry Sand (E1)

Alternative	Advantages	Disadvantages
1. Landfill	1. No new equipment investment 2. Operation simpler than #2	1. Value of reclaimable sand lost 2. Environmental contamination 3. Management required with little or no value regained
2. Reclaim	1. Value of sand reclaimed 2. Environmental quality preserved	1. Disposal of oil/residue mix 2. More complex than #1

(continued)

TABLE 14 (continued)

Waste Type Iron & Steel Slag (E3)

Alternative	Advantages	Disadvantages
1. Demetallize and landfill	1. Reclaimed iron value 2. Reduced slag volumes 3. By-product usable in construction 4. Cost-effective - underway now	1. Reclamation currently not applicable to steel slag
2. Stockpile steel slag for future markets	1. Providing cover is advantageous over current practices	1. Unsightly piles - large quantities 2. Leachate - runoff contamination of ground/surface water

(continued)

TABLE 14 (continued)

Waste Type Caustics (F2)

Alternative	Advantages	Disadvantages
1. Mix with sulfuric acid pickle liquor and landfill sludge	1. Small quantities can be handled 2. Neutralization chemical available at transport cost 3. Maximum environmental protection 4. Uses another waste 5. Minimum cost 6. Sludge disposal already ongoing	1. Need to dispose of sludge
2. Store in hazardous materials landfill	1. Independent of other waste production 2. No sludge disposal	1. Environmental contamination potential 2. Complex management with no gain 3. Highest cost alternative
3. Sell via waste exchange	1. Management simple 2. Eliminates environmental contamination	1. Lack of users

(continued)

TABLE 14 (continued)

Waste Type Hazardous Inorganics (F5)

Alternative	Advantages	Disadvantages
1. Employ existing fixation process and landfill	1. Potential for environmental contamination less than #2 2. Stability greater than #2 3. Management simpler than #2	1. Long term inactivation questionable 2. Potential for soil/groundwater contamination 3. Uncertain proprietary mechanisms and costs
2. Encapsulate in hazardous wastes landfill	1. No proprietary uncertainties	1. Greater potential for environmental contamination than #1

(continued)

TABLE 14 (continued)

Waste Type Hazardous Organics (F3, F4, F7)

Alternative	Advantages	Disadvantages
1. Incinerate in hazardous wastes incinerator	1. Ultimate disposal of highly toxic materials 2. Good environment protection with proper air pollution control 3. Cost effective	1. Air pollution potential 2. Disposal of ash
2. Encapsulate in hazardous materials landfill	1. No air pollution	1. Potential for soil/groundwater contamination 2. Costs for continuous contamination monitoring in perpetuity 3. Management complex
3. Employ existing fixation process and landfill	1. No air pollution 2. Waste re-exposure over #2 reduced	1. Long term inactivation questionable 2. Potential for soil/groundwater contamination 3. Uncertain proprietary mechanisms and costs

(continued)

TABLE 14 (continued)

Waste Type Coke Production Waste Treatment Sludge (F6)

Alternative	Advantages	Disadvantages
1. Landfill	1. No air pollution 2. Current practice 3. Lowest cost alternative	1. Potential contamination soil/groundwater, organics, heavy metals 2. Haul costs 3. Large quantities
2. Incineration	1. Reduce soil/groundwater pollution potential 2. Residue reduction	1. Air pollution potential 2. Ash disposal 3. Investment required 4. Continuing O&M Costs

alternatives such as pyrolosis, solvent treatment of sludges, and in-plant process changes--conversion to hydrochloric acid pickling, and counter-current rinsing--and some were recommended for further study as a part of the "later" program. Eliminations were based on:

- in-plant needs which were largely unknown for individual plants
- technology which was felt to be insufficiently developed to be classed as "off-the-shelf"
- high cost
- insufficient additional environmental quality or resource recovery value to warrant selection over less costly, more readily implementable options.

These decisions must be re-evaluated as time passes since technology changes and/or cost considerations may change rapidly for some of the options.

Physical Facilities

Due to the number of subcategories, physical facilities are presented in tabular form (Table 15). Included in the table are the disposition of each residue classification, responsible "disposer," cost information and pertinent comments.

In order to assist in distinguishing between the initial and later programs and to summarize the transportation needs, the subcategory quantities are summarized on Table 16.

Cost information is also summarized separately for the three alternatives in Tables 17, 18, and 19. Notes providing additional information such as primary assumptions and references for cost data, are given at the end of Table 15.

Cost data are based on: literature sources (as shown in Tables 17 and 18), on-going operations in the Pittsburgh area, or data and information provided by equipment manufacturers or suppliers. References to current operations or suppliers are not given. Option details and further information are presented in References 46 and 47.

Cost estimates, in 1976 dollars, are provided for both capital and annual costs. Annual costs include amortization, interest, operation and maintenance (8% interest for 20 years). Land costs are not included because of site specificity.

Techniques included in the estimated cost for chemical waste landfills include waste segregation, deactivation, waste-soil blending, daily earth cover, leachate monitoring, collection, treatment and clay lining. Encap-

TABLE 15. CENTRALIZED RESIDUE MANAGEMENT SYSTEM - ALTERNATIVE 1

Item	Name	Disposition	By Whom	Total Annual Cost**	Total Capital Cost **	Comment
1. A1	Wastewater Treatment Skimmings	landfill	CA*	See Table 19		See note 1.
2. A2 thru A6,A8	Waste Oil***	reclaim	CA	2.32	7.02	See note 2.
3. A7	Tank Bottoms	incinerate	CA	See Table 19		
4. B1 thru B4	Solvent***	reclaim	CA	0.03	0.04	Residues to be incinerated.
5. C1	Food Processing Sludges	to compost and landfill	CA	See Table 19		
6. C3	Coal Fines	lagoon on-site	Coal companies	--	--	No cost to CA. *
7. C4	Organic Sludges Municipal, Septage	compost and landfill	CA	See Table 19		
8. C5	Cleaning Emulsions	to compost and landfill	CA	See Table 19		

(continued)

TABLE 15 (continued)

Item	Name	Disposition	By Whom	Total Annual Cost**	Total Capital Cost**	Comment
9. D1	Pickle Liquor and Hydroxide Sludges from Pickle Liquor	treat and landfill as interim alternative	CA	See Table 19		Costs shown are for neutralization and landfill; reclaim of pickling acid is possible in future. See note 3.
10. D2	Metal Finishing Sludges***	chemical waste landfill	CA	See Table 19		
11. D4	Hydrochloric Acid Pickle Liquor	reclaim	Private company	--	--	No cost to CA. See note 4.
12. D5	Air Pollution Control	landfill/ recycle	Steel companies	--	--	No cost to CA See note 5.

(continued)

TABLE 15 (continued)

Item	Name	Disposition	By Whom	Total Annual Cost**	Total Capital Cost**	Comment
13. D6	Scrubber Sludges	landfill/ treatment	Steel companies	--	--	No cost to CA. See Note 5.
14. D7	Scale	landfill	Sources/CA	See Table 19		CA only handles amounts that are considered a problem.
15. D8	Air Pollution Control Foundry Dust	landfill	Sources	--	--	No cost to CA.
16. D9	Other Heavy Metal-Containing Wastes	chemical waste landfill	CA	See Table 19		
17, E1	Waste Foundry Sand***	reclaim	CA	0.095	0.17	Mobile unit; no haul cost required.
18. E2	Iron Slag	reclaim Iron & granulated slag	Private company	Profit for private sector		No cost to CA.

(continued)

TABLE 15 (continued)

Item	Name	Disposition	By Whom*	Total BAT Annual Cost**	Total BAT Capital Cost**	Comment
19. E3	Steel Slag	landfill	Sources	--	--	Possible reclamation in future. (Table 20)
20. E4	FGD Sludge	chemical fixation	Power companies	--	--	No cost to CA.
21. E5	Cullet & Glass Manufacturing Residues	landfill on-site	Sources	--	--	No cost to CA. (See Table 20)
22. E6	Cement Dust	landfill on-site	Sources			No cost to CA (See Table 20).
23. E7	Water Treatment Sludges	landfill	CA			See text.
24. E8	Fly Ash Dust	landfill on-site (reclaim as bricks: possible)	Power companies	--	--	No cost to CA. (See Table 20).
25. F1	Acids	neutralize/ landfill	CA	--	--	Small amount, included with sulfuric acid Pickle Liquor (D3)
26. F2	Caustics***	neutralize/ chemical waste landfill	CA	See Table 19		See Table 19.

(continued)

TABLE 15 (continued)

Item	Name	Disposition	By Whom**	Total Annual Cost	Total Capital Cost	Comment
27. F3	Organics	incineration	CA	See Table 19		
28. F4	Waste Paint, Dye	incineration	CA	See Table 19		
29. F5	Hazardous Inorganics	encapsulate/ chemical wastes landfill	CA	See Table 19		Encapsulation costs given; landfill Costs given with landfill totals.
30. F6	Coke Production Waste Treatment Residues	chemical waste landfill	CA	See Table 19		
31. F7	Pitch Sand, Tar	incineration	CA	See Table 19		

NOTES FOR TABLE 15

* CA = Central Agency

** Millions of 1976 dollars.

*** Module sizes used are as follows:

Item	Module
2. Waste Oil	22,000 gal/day
4. Solvent	1000 gal/day
20. Waste foundry sand (38)	30 tons/hr
29. Caustics	100 gal/hr

ADDITIONAL COMMENTS TO TABLE 15

	Item	
1.	A1	An alternative is to use these WWT sludges as fill in strip mining areas in conjunction with proper sanitary landfill techniques and reclamation measures.
2.	A2-A6, A8	Waste oil could also be stored and sold in batches to local waste reclamation firms with an appropriate monitoring, surveillance and permit program if the processing is acceptable environmentally and recovery of waste oils is maximized.
3.	D1	Reclamation of pickle liquor may be used in the future by the steel industry. As reclamation efforts are put into operation, the production of sludges from neutralization processes will decrease. Current costs are for neutralization and landfilling of the sludge. As the quantities change, costs will vary.
4.	D5,D6	Air pollution control (APC) custs could be landfilled with scrubber sludges, or an attempt could be made to reclaim metal value. Private investment could be encouraged to initiate metal reclamation operations if the operation could be shown to be technically and economically feasible.

TABLE 16. PROJECTED RESIDUE QUANTITIES[1]

	Current (1977) quantity		1985 maximum expected quantity tons/day		
	kkg/day	tons/day	Initial Program	Haul Now	Later Program
Waste Oil					
A1. Industrial Treatment Plant Skimmings	2.3	2.5 (3%)	5.7	Yes	---
A2. Machinery Lubricants	0.20	0.22	0.22	Yes	---
A4. Emulsions	4.0	4.4	4.4	Yes	---
A5. Animal Oils & Fats	1.5	1.6	2.5	Yes	---
A6. Cutting Oil	45.0	50.0	76.0	Yes	---
A7. Tank Bottoms	2.4	2.6	5.0	Yes	---
A8. Crankcase Oil	43.0	(10-20%) 48.0	48.0	Yes	---
	98	110	140		
Solvents					
B1. Paint Manufacturing	8.9	9.8	11	Yes	---
B2. Resin Manufacturing	0.69	0.76	1.1	Yes	---
B3. Metal Cleaning	0.91	1	1	Yes	---
B4. Printing, Lithographing	0.17	0.19	0.19	Yes	---
	11	12	13		
Organic Wastes					
C1. Food Processing	16	18 (5%)	18	Yes	--
C3. Coal Fines	520	570	--	No	---
C4. Municipal Treatment Plant Sludge	640	700 (3-20%)	770	Yes	---
C5. Cleaning Emulsions	3.8	4.2 (5%)	9.5	Yes	---
C9. Miscellaneous Organics	22	24 (35%)	70	Yes	---
F4. Waste Paint, Dye	5.6	6.2	6.9	Yes	---
F6 Coke Production Sludge	38	42 (10%)	130	Yes	---
F7. Pitch, Tar	20	22	26	Yes	---
	1300	1400	1000		
Inorganic Wastes					
D1. Iron Hydroxide Sludge	1100	1200 (5%)	3200	Yes	---
D2. Metal Finishing Sludge	91	100 (3%)	--	No	---
D3. H_2SO_4 Pickle Liquor	420	460	600	Yes	---
D5. Air Pollution Control Dusts	61	67	44	No	---

(continued)

TABLE 16 (continued)

	Current (1977) quantity		1985 maximum expected quantity tons/day		
	kkg/day	tons/day	Initial Program	Haul Now	Later Program
Inorganic Wastes (continued)					
D6. Scrubber Sludges	510	560 (10-50%)	--	No	---
D7. Scale & Treatment Sludges	10	11	480	Yes	---
D8. Air Pollution Control Dusts/ Foundries	19	21	--	NO	22
D9. Other Heavy-Metal Containing	1.5	1.6	1.6	Yes	---
F3. Miscellaneous Inorganics	4	4.4	6.3	Yes	---
	2200	2400	4300		150
Other Wastes					
E2. Iron Slag	4300	4700	--	No	---
E3. Steel Slag	3200	3500	--	No	3500
E4. FGD Sludge	510	560	--	No	---
E5. Cullet, Glass Manufacturing	4.2	4.6	--	No	7.4
E7. Water Treatment Sludge	1500	1700 (5%)	460 (20%)	Yes	---
E8. Fly Ash	1800	2000	--	No	2000
E1. Foundry Sand	96	110	240	No	---
F2. Caustics	9	10	12	Yes	---
F6. Cement Dusts	100	110	--	No	120
	11,500	12,600	700		5,600
TOTALS	15,100	16,600	6,160		5,800

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[1] All sludges are wet basis (solids concentrations).

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TABLE 17. A. INITIAL PROGRAM
PRELIMINARY TREATMENT AND DISPOSAL COST SUMMARY
(1976 Dollars - Wet Basis)

Processing	Maximum expected quantity 1985 tons/day	Capital cost million \$^{1}	Total annual cost million \$^{3}	Net annual cost million \$^{2}
Waste Oil Reclamation (37)	130	7.02	2.32	--
Solvent Recovery	13	0.04	0.03	-0.24
Waste Foundry Sand Cleaning (38)	240	0.17	0.095	-0.55
Caustics and Pickle Liquor Neutralization (28)	600	3.9	2	0.004
Subtotal	980	11.1	4.4	-1.2
Incinerator (39, 40, other)				
Solvent Residues	3.3			
Tank Bottoms	5			
Misc. Organics	70			
Waste Paint	6.9			
Pitch, Tar	26			
Subtotal	110	2.1	1.1	1.1
Landfill (39, 41, 42)				
WWT Oily Skimmings	5.7			
Iron Hydroxide/Acid Rinse Sludge	3200			
Sulfuric Acid Pickle Liquor Sludge	1200			
Scale and Sludge	480			
Water Treatment Sludge	450			
Subtotal	5300	6.3	3.1	2.2
Special Landfill				
Other HM	1.6			
Caustics	24			
Coke Waste Treatment Sludge	130			
Metal Finishing Sludge	130			
Subtotal	290	2.6	1.2	3.0

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TABLE 17 (continued)

Encapsulation	Maximum expected quantity 1985 tons/day	Capital cost million $[1]	Total annual cost million $[3]	Net annual cost million $[2]
Inorganics	6.3	--	.04	.04
Composting & Landspreading (41)				
Industrial Organic Sludges	28	--		
Municipal Organic Sludges	770	--		
Subtotal	800	1.0	1.8	1.8
TOTAL	7500	23.1	11.6	6.9

[1] Land cost not included.

[2] Represents cost after allowance for reclamation revenues.

[3] 8% interest for 20 years.

[4] Costs are based on total amounts shown or module sizes as follows:

Waste Oil	100 tons/day
Solvent Recovery	4.2 tons/day
Waste Foundry Sand	170 tons/day

TABLE 18. B. LATER (TOTAL) PROGRAM PRELIMINARY COST SUMMARY

	Maximum expected quantity tons/day	Capital	Total annual	Net annual
Initial Program	7500	23.1	12	6.9
Metal Finishing Sludge [1] (43) Reclamation	--	8.7	3.4	0.63
Electro-magnetic Metal Recovery Steel Slag Scale/Sludge APC Dusts/Foundry	3500[2]	.55	0.13	0.13
Brick Making (44, 45) Cullet/Glass Cement Dust Fly Ash	1000[3]	8.5	7.5	-9.1[4]
	12000	41	23	-1.4

[1] Development Stage - costs based on module size 100 tons/day - quantity included in the initial program.

[2] 480 tpd scale included in initial program; demetallizing represents a different alternative.

[3] 50% of County production in these categories; no market analysis has been made.

[4] at $78/1000 bricks.

TABLE 19. C. PROGRAM WITHOUT STEEL WASTES[1] OR MUNICIPAL WASTES

	Tons/day	Capital costs million $	Annual cost	Trans-portation	Total annual cost
Processing	400	7.2	2.5	0.2	2.7
Incinerator	110	2.1	1.1	0.2	1.3
Landfill	940	1.5	0.5	1.3	1.8
Metal Finishing Sludge Landfill	130	included with landfill	0.1	0.2	0.3
Special Landfill	26	0.8	0.5	0.1	0.6
Encapsulation	6.3	--	0.04	included with special landfill	.04
Composting/Land Spreading	28	0.2	0.1	0.1	.2
	1640	11.8	4.8	2.1	6.9

---

[1] Scale and scale sludge treatment are included.

sulation costs, where judged necessary, are given separately in Tables 17, 18, and 19. Sanitary or regular landfill costs include spreading wastes in thin layers, compacting, and covering wastes daily with a layer of soil without the other precautions.

Table 15 presents the types and quantities of residues destined for disposal by incineration and presents the capital and annual costs for this disposal method. In general, these residues are either potentially hazardous and/or have some caloric value which will help sustain combustion. An attempt was made to keep incineration requirements to a minimum in order to minimize air pollution problems. Also included are data on composting and landfill of organic sludges including residues from Food Processing (C1), Municipal Waste Treatment (and Septage) (C4), and Cleaning Emulsions (C5).

Detailed transportation costs are presented for the initial program (Table 20), the later program (Table 21), and are included with the limited program (Table 19). The data also include the number of trucks required and unit cost estimates for convenience. The estimates were developed as discussed in a previous section. The South Park site was arbitrarily chosen in order to develop the estimates and average transportation parameter values were used. The transportation costs will vary depending on each of the parameters discussed but will vary significantly with distance to the site. Transportation costs are a substantial part of the total program costs and any reduction will lower total costs appreciably.

Table 22 presents data for current residue treatment and disposal costs. The estimate is based on the same residue types used to develop the initial program estimates so that a comparison can be made. Current cost estimates were not available for all the categories shown in Table 1. Table 23 indicates the costs estimated if current residue disposal practices were continued, at current cost levels, and applied to quantities generated in the future.

As previously mentioned, wastes from steel making operations constitute the major portion of residues generated in Allegheny County. These large quantities tend to obscure the importance of disposal of lesser quantities from small manufacturing and processing industries in the county. Similarly, sludges from municipal waste treatment plants represent a large portion of the total organic residue generation. These wastes could be handled by the publicly-owned treatment plant authorities on an individual basis.

System Administration

Table 24 presents a summary of estimated costs for administration and management of the alternatives. These costs include the staff (with office space, supplies, etc.) to support the various collection, treatment and disposal operations. Routine operating and maintenance costs for the unit operations are already included in the annual cost estimates for each operation and truck drivers are included as a part of the transportation estimate. Administration costs are not likely to increase significantly between the

TABLE 20. TRANSPORTATION COSTS INITIAL PROGRAM

	Tons/day	Annual cost	No. trucks	Unit cost/ton
Waste Oil	130	$ 200,000	3	$ 4.20
Solvents	13	32,000	7	6.70
Pickle Liquor*	--	--	--	--
Foundry Sand	240	0	0	0
Caustics*	12	--	--	--
Incineration	110	180,000	3	4.50
Landfill	4100	5,000,000	74	3.30
Special Landfill	156	170,000	2	3.00
Composting/Land Application	800	1,300,000	21	4.40
Pickle Liquor Sludge*	1200	2,200,000	32	5.10
TOTALS	6800	$ 9,100,000	142	$ 3.67

*Costs included for hauling pickle liquor sludge, not for hauling pickle liquor to a separate treatment site. 12 tons/day of pickle liquor used to neutralize caustics.

TABLE 21. TRANSPORTATION COSTS LATER (TOTAL) PROGRAM

	Tons/day	Accrued cost	No. trucks
Initial Program	6800	$ 9,100,000	142
Metal Finishing Sludge	130	200,000	3
Electro-magnetic Metal Recovery	520	1,000,000	14
Brick Making	130	250,000	4
TOTALS	7580	$ 10,600,000	163

*Hauling costs included in pickle liquor.

TABLE 22. CURRENT RESIDUE TREATMENT AND DISPOSAL COSTS*
(Alternative A Basis)

	Daily amount (wet basis) tons/day	Current disposal unit cost $/ton	Total annual cost
Oily Waste	108	14.40	$ 570,000
Spent Solvents	12	60.00	260,000
Organics	22	6.00	50,000
Municipal Sludge			
Dewatering	716	7.00	1,800,000
Incineration	486	20.00	3,500,000
Landfill	230	6.00	500,000
Hydroxide Sludge	1200	4.80	2,100,000
Metal Finishing Sludge Spent Pickle Liquor	560	14.40	2,900,000
Air Pollution Residues, Scale	500	3.00	550,000
Foundry Sand	106	6.00	230,000
Water Treatment Sludge	1800	6.00	3,700
Miscellaneous	45	38.00	620,000
Coke Wastes, Other	64	6.00	140,000
	5100		$17,000,000

* Based on unit costs reported by industries.

TABLE 23. RESIDUE TREATMENT AND DISPOSAL COSTS
(Later [Total] Program Basis Using Current Costs)

	Daily amount tons/day	Current disposal unit cost $/ton	Total annual cost
Initial Program	5100	--	$ 17,000,000
Slag	3500	3.00	4,100,000
Cullet, Cement Dust	130	3.00	140,000
Fly Ash	1900	3.00	2,100,000
	10,300 [1]	TOTAL	$ 23,200,000

---

[1] Does not include 1200 tpd of sludge from treatment of pickle liquor.

TABLE 24. RESIDUE MANAGEMENT SYSTEM ADMINISTRATION COSTS*

1 Director	
1 Assistant Director	
1 Engineer	
1 Maintenance Supervisor	
1 Operations Supervisor	
1 "Broker"	
2 Dispatchers	
2 Clerks	
Total	$ 330,000

*Based on use of 100% overhead and benefits rate, including secretaries, telephone, rent, office equipment, analyses, etc.

initial and later programs since management needs are expected to increase only slightly. Conversely, the administrative requirements will be about the same for the smaller option which excludes the steel wastes and municipal sludges with the possible exception of a second dispatcher and clerk. The same estimate therefore was used in all three alternatives. Note that an overhead rate of 100% of salaries was used to account for fringe benefits, office space, equipment, laboratory analysis, etc.

MANAGEMENT AND IMPLEMENTATION

Since it is not certain whether transportation and other associated handling, storage and disposal costs are included in current cost estimates (see Table 22), Tables 25 and 26 were developed to present comparisons with and without transportation, respectively. The ranges of cost presented reflect an estimate of the value of recovered resources--metals, bricks, etc.

The results of this study should be considered very preliminary in nature. This study can provide the basis for further discussion and the development of a more detailed analysis during the next phase--preliminary design.

Although the individual elements of the residue handling and disposal program have been grouped into alternatives, other groupings are possible as previously discussed. In fact, it is likely that a program finally chosen for implementation will be different from the alternatives presented here. A more detailed analysis planned for the preliminary design stage may eliminate some elements because of cost or technicanl feasibility.

Any of the centralized management alternatives would provide cost effective treatment and disposal of residues while preserving environmental quality as related to the land resource and ground and surface water quality.

Resource recovery could provide cost savings depending on the market prices. Recovered sale value of oil, foundry sand, metals, solvents, sulfuric acid and iron values from waste pickle liquor, and the recovered value of building materials could offset the annual costs significantly. Even if implementation of some recovery options is delayed, effective centrally-managed landfill and storage operations represent a stockpile of potentially recoverable values.

In addition to estimated cost differentials, there are differences among alternatives in performance or effectiveness that can be postulated. A highly centralized system could have the following advantages over the current approach:

- Reduction in the number of disposal sites.
- Ability to provide more expertise in the central staff to promote lower cost and more effective management operations.

TABLE 25. COST COMPARISONS[3]
(With Transportation)

Alternatives	Capital cost million $	Annual cost million $	Unit cost $/ton
Using Current Disposal Option	--	17.1[1]	9.20
Using Initial Program Basis	23.1	16.3-21.1[2]	6.00-7.70
Using Later (Total) Program Basis	41	11-34[2]	2.50-7.80
Later Cost With Existing Options	--	23[1]	5.80
Program Without Steel Wastes or Municipal Residues	12	7.2[2]	12

[1] Total transportation costs may not be included.

[2] Includes administrative costs.

[3] Ranges based on possible values of recovered materials.

TABLE 26. COST COMPARISONS[3]
(Without Transportation)

Alternatives	Capital cost million $	Annual cost million $	Unit cost $/ton
Using Current Disposal Options	--	17.1[1]	9.20
Using Initial Program	23.1	7.2-12[2]	2.60-4.40
Using Later Total Program	41	0-23.3[2]	0-5.30
Later Cost With Existing Programs	--	23.2[1]	5.80
Program Without Steel Wastes or Municipal Residues	12	5.1[2]	8.50

[1] Some transportation may be included in industry provided estimates.

[2] Includes administrative costs.

[3] Ranges based on possible values of recovered materials.

- Simpler monitoring and surveillance requirements because of fewer sites.

- Higher probability of success for a waste exchange.

- More assured supply of wastes and less variation in delivery rates to reclamation, treatment and disposal operations.

Advantages of a less centralized approach are:

- Smaller amounts of materials at individual disposal sites.

- Fewer problems in dealing with multiple political jurisdictions.

- Less transportation of residues, in terms of mileage, which would reduce the chances of spills.

- Fewer types of wastes handled per site, thus lowering the degree of complexity of the operation.

From Tables 25 and 26 it appears that the annual cost of continuing the highly dispersed, individual residue disposal system ($17 million) is close to that for the other alternatives. However, the cost estimate for continuing in the present mode is considered low because:

1. The unit cost data for Tables 22 and 23 were derived from discussions with plant personnel. Data on disposal costs in most cases were not well documented or defined and typically consisted of on-the-spot estimates.

2. In many cases, transportation was not included in the disposal unit costs.

3. Unit costs often represented only out-of-pocket costs. Amortization and interest charges or the internal costs of managing a corporate disposal program may not have been included in the unit costs.

4. Current practices respond to the enforcement level of current regulations; it is expected that many current disposal techniques will have to be upgraded, resulting in higher costs.

5. Costs are incurred in the proposed alternatives for reclamation of materials. The economic benefit of reclamation has been included in the cost estimate comparisons by showing a range of expected cost. There is uncertainty in the market for reclaimed materials, however. While an accurate estimate is not available at this time, one can predict that economic benefits will accrue that could be used to lower the annual costs of the "centralized" alternatives.

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As mentioned earlier, there will be much greater federal and state regulatory activity in the area of disposal of toxic and hazardous materials. This, coupled with emphasis on regional, comprehensive water quality management (e.g., 208 plans) will result in increasing regulatory activity toward tighter restrictions on residue handling and disposal. If history is a guide, the state will either assume some of the new regulatory functions or promulgate and enforce new, more stringent requirements. This, of course, will tend to increase the cost of the completely dispersed approach, thus improving the potential for a regional residue management system.

There are a number of significant non-monetary advantages of centralized systems over the present dispersed approach:

1. Capability for close control of adverse environmental impacts of residue disposal because of the large reduction in the number of disposal sites (from several hundred).

2. Many industries and municipalities will be faced with the problem of obtaining additional land for treatment/disposal operations. This problem would be lessened for centralized systems because fewer sites are needed. Industries would be assured of a local treatment/disposal outlet for hazardous wastes.

3. Centralized systems would reduce the amount of effort required by industries to monitor disposal practices and interface with regulatory agencies.

4. Because of economies-of-scale, higher level technical expertise could be applied to treatment/disposal/reclamation operations as well as monitoring in centralized systems, without cost penalty.

5. Because of the concentration of residues, centralized systems would offer better opportunities for reclamation or waste exchange.

There are a number of institutional/regulatory considerations that are important for successful residue management (see Appendix VII).

One area that merits special concern is that of waste oils. Most waste oil generated is spent crankcase oil. Unlike other residues studied, crankcase oil is generated by many sources (i.e., automobiles, trucks, etc.). Waste oil disposal from service stations could be controlled by effective regulatory action. However, a large number of car and truck owners change their own oil; disposition of waste oil from these sources would be much more difficult to control. In addition to regulatory action, a strong public information program, coupled with financial incentives, may be required. Waste oil repositories could be required at all service stations and could be encouraged at shopping centers or retail outlets that sell automotive oils.

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Septage also requires special considerations. In this case, septic tank pumping companies could be licensed for operation. Continuation of the license would depend upon disposal of septage in an approved manner.

The alternatives described herein include a variety of unit operations designed to treat or dispose of specific waste types. It is important that mixing of incompatible wastes be prevented. A county or area-wide system will need an effective technical program to instruct residue generators, particularly small operations, on proper handling and storage techniques.

As part of an overall residue management program, a permit system for all operator-owners of residue management facilities could be considered. This would accomplish several objectives:

1. Monitor quantities managed
2. Monitor energy and resource recovery and values
3. Assist in environmental quality monitoring
4. Assist in locating and training of operators
5. Monitor wastes from recovery facilities
6. Serve as an early information source on which to base initial and expanded programs for residue management.

The financial and institutional aspects of the program could be managed by:

1. County government
2. Newly created public authority at county level
3. Public corporation similar to power companies
4. Private enterprise
5. Combinations of the above.

During the early design stages of a centralized system, firm commitments must be obtained from major residue generators to ensure a supply of materials for the processing facilities. A more detailed definition of waste amounts, characteristics, and locations must be obtained before physical systems can be designed in more detail. Also, systems should be optimized with respect to site size and location, module design and capacities, and transportation equipment and routes. This will provide a firmer delineation of potential costs and, therefore, provide a basis for commitment by potential contributing waste generators. It would also be desirable to develop contractual arrangements with users of reclaimed materials to ensure customers for system outputs and to be able to realistically account for potential economic benefits.

It must be noted that at the present time there is interest in developing a centralized system for Allegheny County and the next phase has been funded and is underway. A scenario which may occur is the development of an Allegheny County system followed by inclusion of surrounding counties as the system economics and effectiveness prove attractive. This approach would promote the development of a large regional system with minimal need for initial agreement between the many political jurisdictions in southwestern Pennsylvania.

Industrial Participation

An ad-hoc committee of local industrial representatives was formed and met three times during the study--early in the study--to receive findings about midway through the study, and to review and comment on the findings near completion of the study. The ad-hoc committee consisted of representatives from:

1. Allegheny County Health Department
2. Allegheny County Works Department
3. Blaw-Knox Foundry and Mill Machinery, Inc.
4. The Chester Engineers
5. Continental Can Co., Inc.
6. Environmental Quality Systems, Inc.
7. Glenshaw Glass Company
8. Graphics Arts Technical Foundation
   (Herbick & Held Printing Co.)
9. Hanlon-Gregory Galvanizing Co.
10. ITT Continental Baking Co.
11. J & L Steel Company
12. Neville Chemical Co.
13. Office of R & D, U.S. EPA
14. Pennsylvania Department of Environmental Resources
15. Pittsburgh Metal Lithographing Co.
16. PPG Industries, Inc.
17. Reichold Chemical, Inc.
18. Russell, Burdsall & Ward, Inc.
19. Shenango, Inc.
20. St. Regis Paper Co.
21. Teledyne-Columbia Somerill, Inc.
22. University of Pittsburgh
23. U.S. Steel Corporation
24. Vulcan Materials Co.
25. Westinghouse Air Brake Co.

Through the ad-hoc committee, industry has had the opportunity to contribute to the development of the Allegheny County industrial residue management proposals. Over 50% of the industries contacted enthusiastically responded to the idea of the system. Even though there was no negative reaction to the preliminary proposals, solid industrial commitments must be made during the next phase of the project--the signing of contingent contracts for use of the system. Then the next design phases and construction of the system can be initiated.

Financing

A program which is centralized for the disposal of residues in Allegheny County should be based on a system of user charges. Contractual arrangements between the central agency and the users of the system could be developed with considerations as follows:

1. The users would agree to make periodic service payments totalling an amount required to pay interest and principal on bonds issued to provide funds for construction of the system plus, perhaps, an amount to provide a reserve.

2. The user charges would include operating and maintenance expenses.

3. The agreement should probably contain specific conditions under which residue quantities might be adjusted, with subsequent adjustments in the user obligations; some users might be terminated while others might be substituted.

4. The capacity which is originally constructed for treatment handling and disposal mechanisms would originally be contracted for by the initial users. Initial user obligations could perhaps be adjusted as new users are accommodated into the system.

Service contracts with potential users could provide the basis for issuance of revenue bonds to finance the construction costs which would not be financed by federal or state grants. The revenues from the system would be the security for the revenue bonds.

The projections of revenue bond requirements, the need for and magnitude of a reserve fund, additional bonds for system improvements, the need for and magnitude of refunding bonds, and bonds for replacement purposes should be the subject of further examination during the preliminary design phase which will follow this initial study.

A more detailed examination would include the following factors:

A. The total initial capital requirements.

B. Additional capital requirements in increments, after the initial outlay and up to completion of the project.

C. The availability and amount of federal assistance available for construction--federal assistance might be available through the Clean Water Act and the Resource Conservation and Recovery Act, through the U.S. Environmental Protection Agency. Such grants would be made through and be augmented by the State of Pennsylvania funds.

With or without federal and/or state financing, Allegheny County may, either separately or in combination with other municipal and/or public groups, finance, construct and operate a system through an existing department, or by establishing a separate public authority. The system could be owned by the authority and operated by a separate organization, either public or private, through lease or other contractual arrangements.

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REFERENCES

1. Pennsylvania Industrial Census Series. Allegheny County, No. N5-74, Pennsylvania Department of Commerce, Harrisburg, Pennsylvania, 1975.

2. 1976 Pennsylvania Industrial Directory. 24th Edition, Bureau of Statistics , Research and Planning, Commonwealth of Pennsylvania, 1976.

3. Comprehensive Water Quality Management Plan, Ohio Valley Study Area, Study Area 9. Chapter VII, Existing Water Quality Management Program, Commonwealth of Pennsylvania, Department of Environmental Resources, 1976. 154 pp.

4. Development Documents for Effluent Limitations Guidelines and New Source Performance Standards (all industrial categories). U.S. Environmental Protection Agency, Washington D.C., 1973-1976.

5. Stone, R. Forecasts of the Effects of Air and Water Pollution Controls on Solid Waste Generation. Ralph Stone and Company, Inc., Los Angeles, California, December 1974.

6. Ottinger, R.S. Recommended Methods of Reduction, Neutralization, Recovery, or Disposal of Hazardous Waste. TRW Group, Redondo Beach, California, August 1973.

7. Information Transfer Inc. Proceedings of the National Conference on Management and Disposal of Residues From the Treatment of Industrial Wastewaters. Washington D.C., February 3-5, 1975. 274 pp.

8. Analysis of Effluent Control Technology and Associated Costs for the Iron and Steel Industry. Arthur G. McKee and Company, Cleveland, Ohio, 1975.

9. SEAS Phase III Data Documentation. Strategic Environmental Assessment Studies, International Research and Technology Corporation, Arlington, Virginia, August 6, 1975.

10. Report to the National Commission on Water Quality on the Environmental Impact of the Disposal of Wastewater Residuals. Environmental Quality Systems, Inc., Rockville, Maryland, 2 vols., March 1976. 558 pp.

11. Schiffman, A. Disposal of Hazardous and Industrial Wastes in Maryland. Report to the Legislative Councils of the Maryland General Assembly by the Water Resources Administration of the Maryland Department of Environmental Resources, November 1, 1975.

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PAGE NUMBER
EPA-287 (Cin.)
(4-76)

12. Hazardous Waste Management Planning 1972-1973. State of Oregon, Department of Environmental Quality, March 1974.

13. Solid Waste Management Plan, 1971, Allegheny County, Pennsylvania. Green Engineering Company, Sewickley, Pennsylvania, March 12, 1971.

14. American Iron and Steel Institute. The Making of Steel. Washington D.C. 94 pp.

15. Development Document for Effluent Limitation Guidelines and New Source Performance Standards for the Steel Making Segment of the Iron and Steel Manufacturing Point Source Categories. U.S. Environmental Protection Agency, June 1974.

16. Pasztor, L., and S.B. Floyd, Jr. Pollution Abatement Residues Arising in the Iron and Steel Industry. Third National Conference on Complete Water Reuse, Cincinnati, Ohio, June 27-30, 1976.

17. Akerlow, E.V. Economical Uses of Steel Plant Wastes. Iron and Steel Engineer, February 1975. pp. 39-41.

18. Mathias, M.M. and Adran Goskel. Reuse of Steel Mill Solid Wastes. Iron and Steel Engineer, December 1975. pp. 49-51.

19. Brinsko, G.A., E.J. Martin, A.P. Pajak and D.M. Jordan. Hazardous Material Spills and Responses for Municipalities. U.S. Environmental Protection Agency, Office of Research and Monitoring, Washington D.C., 1976. 258 pp.

20. Commonwealth of Pennsylvania. Pennsylvania Standards for Contaminants. Title 25, Part I, Subpart C, Article III, Chapter 123, Standards for Contaminants, Effective August 9, 1976a.

21. Commonwealth of Pennsylvania. Pennsylvania Standards for Sources. Title 25, Part I, Subpart C, Article III, Chapter 129, Standards for Sources, Effective August 9, 1976b.

22. U.S. Environmental Protection Agency. Environmental Protection Agency Regulations on Standards of Performance for New Stationary Sources. 40 CFR 60, Effective August 17, 1971, as Amended.

23. U.S. Environmental Protection Agency. Environmental Protection Agency Regulations on National Emission Standards for Hazardous Air Pollutants. 40 CFR 61, as Amended by Code of Federal Regulations, Volume 40 and Revised.

24. U.S. Environmental Protection Agency. Compilation of Air Pollutant Emission Factors. Second Edition, Publication No. AP-42, Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency, Research Triangle Park, North Carolina, April 1973.

25. Burgess and Niple, Ltd. Waste Sludge and Filter Washwater Disposal from Water Softening Plants. Ohio Department of Health, September 1969.

26. The Chester Engineers. Water & Wastewater Residue Management Study: Allegheny County, Pennsylvania, Preliminary Draft. Coraopolis, Pennsylvania, March 1977.

27. U.S. Environmental Protection Agency. In: Proceedings of the Symposium on Flue Gas Desulfurization, Industrial Environmental Research Laboratory, New Orleans, March 1976. pp. 215-216, 572.

28. U.S. Environmental Protection Agency. Development Document for Interim Final Effluent Guidelines and Proposed New Source Performance Standards for the Forming, Finishing, and Specialty Steel Segments of the Iron and Steel Point Source Category. Office of Water and Hazardous Materials, Washington D.C., 1976.

29. Westeroff, G.P., and M.P. Daly. Water Treatment Plant Waste Disposal, Part 3. Journal American Water Works Association, 6(7): 441, July 1974.

30. Vitberg, A.K., M.L. Rucker, and C.H. Porter. Implementing "Best Management Practices" for Residuals: The Waste Exchange. U.S. Environmental Protection Agency 440/9-76-019, Washington D.C., June 1976.

31. Henriken, P. One Private Plant Treats Oil, Chemical Residues in Denmark. Solid Wastes Management Magazine, May 1974.

32. St. Louis Regional Commerce and Growth Association. St. Louis Industrial Waste Exchange: Operations and Procedures. 1975.

33. Tapperson, M. Press Release by the St. Louis Regional Commerce and Growth Association. St. Louis, Missouri, May 5, 1976. 2 pp.

34. Lehman, J. Personal Communication. EPA Office of Solid Waste Management Planning, March 4, 1977.

35. Ris, C. Visit to Treatment Plant Constructed by PEC Engineering, Hambourg. EPA Memorandum to File, February 19, 1975.

36. Arthur D. Little, Inc. Waste Clearinghouses and Exchanges: New Ways for Identifying and Transferring Reusable Industrial Process Wastes. NTIS No. PB-261 287, Cambridge, Massachusetts, October 1976.

37. Waste Oil Recycle/Recovery Program for State of Maryland. Maryland Environmental Service and U.S. EPA, Environmental Quality Systems, Rockville, Maryland, 1974. 248 pp.

38. Gumtz, G.D. Restoration of Beaches Contaminated by Oil. EPA Publication R2-72-045, Philadelphia, Pennsylvania, September 1972.

39. Engineering Science, Inc. Sludge Processing, Transportation and Disposal/ Resource Recovery: A Planning Perspective. EPA No. WPD 12-75-01, NTIS No. PB 251-013, U.S. Environmental Protection Agency, Washington D.C., December 1975. p. 93.

40. Scurlock, A.C., A.W. Lindsey, T. Fields, Jr., and D.R. Huber. Incineration in Hazardous Waste Management. Publication SW-141, U.S. Environmental Protection Agency, Washington D.C., 1975.

41. Sludge Processing and Disposal, (LA/OMA Project). A State of the Art Review. U.S. Environmental Protection Agency, California Water Resources Board, Los Angeles County Sanitary District, Orange County Sanitary District, City of Los Angeles, April 1977.

42. Fields, T., and A. Lindsey. Landfill Disposal of Hazardous Wastes: A Review of Literature and Known Approaches. EPA No. SW-165, U.S. Environmental Protection Agency, Washington D.C., June 1975. p. 10.

43. Ammonium Carbonate Leaching of Metal Values from Water Treatment Sludges. IERC, U.S. Environmental Protection Agency, Cincinnati, Ohio, EPA 600/2-77-105, June 1977.

44. Cockrell, C.F., and H.E. Shafer. A Technical Evaluation of the WVU-OCR Process for Producing Fly Ash-Based Structural Materials. Coal Research Bureau, West Virginia University, Morgantown, West Virginia, Report No. 40, May 1969.

45. Humphreys, K.K. Operating and Capital Costs of Producing Fired Structural Products from Waste Coal Ash. Coal Research Bureau, West Virginia University, Morgantown, West Virginia, Report No. 98, July 1974.

46. Berman, D., E.J. Martin and J.J. David, Jr. An Industrial Residue Management System for Allegheny County, Pennsylvania - Part I. In: Proceedings of Treatment and Disposal of Industrial Wastewaters and Residues, Houston, Texas, April 26, 1977. Information Transfer Inc., Rockville, Maryland. p. 255-265.

47. Martin, E.J., D.L. Guthrie and D. Berman. An Industrial Residue Management System for Allegheny County, Pennsylvania - Part II. In: Proceedings of Treatment and Disposal of Industrial Wastewaters and Residues, Houston, Texas, April 26, 1977. Information Transfer Inc., Rockville, Maryland. p. 266-276.

APPENDIX A

RESIDUE PRIORITY SYSTEM

1. First, all industries discharging directly to streams are retained for analysis (identified through federal and state discharge permits). The priority system which eliminates remaining establishments producing small amounts or no residue, is based on the type, size, and location of the plant:

Type: each industrial classification (by a 4-digit Standard Industrial Code--SIC) is given a rating based on the potential water quality impact of its waste discharge--A (serious), B (moderate), C (slight)* (Table A-1). The more detrimental the waste discharged by a plant, the more likely it is that it will provide treatment and produce a significant residue.

Size: employment data is available for each establishment and should be used to estimate the size of the plant. Small plants which produce insignificant or no residues can be eliminated on this basis, with cutoff points being lower for SIC's with a higher water quality impact potential.

The larger the sewer service area, the larger the industry that may be eliminated (because of dilution and assimilation potential).

2. For plants within large service areas retain:

SIC Class	Employment
A (serious) - with no pre-treatment requirements and	50
B (moderate) - with no pre-treatment requirements and	200
C (slight) - with no pre-treatment requirements and	500

3. For plants within small sewer service areas retain:

A - with no pre-treatment requirements and	10
B - with no pre-treatment requirements and	50
C - with no pre-treatment requirements and	500

4. For remaining plants outside sewer service areas retain:

A - all plants	
B - with no pre-treatment requirements and	10
C - with no pre-treatment requirements and	50

*Note that these are the same ratings as for industrial wastes.

When pre-treatment is known, known to be required or adjudged to be required, the plant is retained for analysis. Industrial facilities in the following SIC codes should be retained in the study, regardless of location; they have been determined to either currently require pretreatment, or will definitely require pretreatment by 1977 or 1983, or produce significant amounts of process or air pollution control residues, or hazardous wastes:

SIC	TYPE	
2813	Industrial Gases	
2812	Alkalis and Chlorine	
2816	Inorganic Pigment	
2819	Industrial Inorganic Chemicals	
2834	Pharmaceuticals	
2851	Paints, Varnishes	
2865	Cyclic Products	
2891	Adhesives, Sealants	
2892	Explosives	
2893	Printing Ink	
2899	Other Chemicals	
3292	Asbestos	
3312	Blast Furnaces	
3317	Steel Pipe, Tubes	
3321	Gray Iron Foundries	
3325	Steel Foundries	
3339	Non-Ferrous Smelting	
3351	Copper Rolling	
3356	Non-Ferrous Rolling	
3361	Aluminum Foundries	
3362	Brass Foundries	
3471	Electroplating	
3479	Coating, Engraving	
4911	Power Plants	
4941	Water Treatment	(>.10 MGD)
4952	Municipal Waste Water Treatment	(>.10 MGD)

Location--an industrial plant not possessing a discharge permit and located within a sewer service area can be assumed to discharge to the corresponding municipal treatment plant. If the exact location of the industrial plant within the municipality is not known, it was assumed to lie within a sewer service area if 75% of the municipality is sewered. These establishments do not generate wastewater treatment residues at the site unless there are pretreatment requirements. All industries for which pretreatment is currently required or will be required should be retained. Larger plants can be retained, even if wastewater treatment residues are not generated, to determine if significant amounts of process or air pollution control residues are generated (which may in turn have a water quality relationship).

In order to include all water treatment, air pollution control, and process residues generated within the study area, the industries isolated by the priority system were augmented by residue-producing service SIC's such as power plants, municipal wastewater treatment plants, and water treatment plants as well as mining-related activities such as coal preparation and acid mine drainage treatment facilities.

TABLE A-1. WATER QUALITY IMPACT POTENTIAL OF STANDARD INDUSTRIAL CLASSIFICATIONS

SIC Code	Industry Group	Rating (1)	pH	Total Dissolved Solids (TDS)	Total Suspended Solids (TSS)	Nutrients	Cyanide (CN)	Metals (2)	Toxic Metals (3)	Chromium (Cr)	Oil and Grease	Phenol	Chlorinated Hydrocarbons	Ammonia Nitrogen	F.Coli.	Sulfide	BOD$_5$	COD	TOC	Other (4)
01-02	Agriculture	B		X	X	X								X	X		X	X		P,N,K
092	Fish Hatcheries	C			X	X									X		X			
12-13	Coal, Gas Processing	A	X	X	X		X	X	X	X	X									A,R
14	Mineral Processing	C		X	X			X												
15-17	Construction	C			X															
201	Meat Products	A		X	X						X			X	X		X		X	
202	Dairy Products	A		X	X						X				X		X			
203	Preserved Foods	A	X	X	X						X				X		X			
204	Grain Mills	C		X	X						X				X		X			
205	Bakeries	B		X	X										X		X			
206-209	Misc. Foods	A	X	X	X	X					X				X		X			
22	Textiles	A	X	X	X					X	X	X			X	X				T,C,Alk
23	Apparel	C	X	X	X				(Hg)	X							X			F
24	Lumber & Wood	C			X														X	
2491	Wood Preserving	A	X	X	X			(Cu)	(Hg)	X	X	X					X		X	
25	Furniture	C	X	X	X	X													X	

(continued)

TABLE A-1 (continued)

SIC Code	Industry Group	Rating (1)	pH	Total Dissolved Solids (TDS)	Total Suspended Solids (TSS)	Nutrients	Cyanide (CN)	Metals (2)	Toxic Metals (3)	Chromium (Cr)	Oil and Grease	Phenol	Chlorinated Hydrocarbons	Ammonia Nitrogen	F. Coli.	Sulfide	BOD$_5$	COD	TOC	Other (4)
26	Paper Products	A	X	X	X			X	X	X		X			X		X	X	X	C
27	Printing & Reprod.	C	X	X	X						X		X							C
281	Inorganic Chem.	A	X	X	X	X	X	X	X	X								X		R
282	Synthetic Fibers	B	X	X	X			X	(Hg)		X	X	X				X	X		
283	Pharmaceuticals	A	X	X	X		X		X		X	X	X		X		X	X		
284	Soap, Detergents	A	X	X	X		X				X	X	X		X		X	X		S
285	Paint, Varnish	A	X	X	X		X	X	X	X	X	X	X				X	X		
286	Org. Chemicals	A	X	X	X	X	X	X	X	X	X	X	X				X	X	X	S
287	Agricult. Chem.	A	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X		F,N,B
289	Misc. Chem.	A	X	X	X			X	X	X	X	X			X		X	X	X	F,P
29	Petroleum Refin.	A	X	X	X		X	X	X	X	X	X		X		X	X	X	X	Cl, T
30	Rubber & Plastics	B	X	X	X					X	X	X	X				X	X		Cl, S
31	Leather Products	B	X	X	X					X	X					X	X	X		H, K
32	Stone, Clay, Cement.	C	X	X	X					X	X	X								C, Alk
322-323	Glass Products	B	X	X	X			X	X		X	X					X	X		P
331	Blast Furnaces, Steel Works	A	X	X	X		X	X	X	X	X	X		X		X				F,A,T

(continued)

TABLE A-1 (continued)

SIC Code	Industry Group	Rating (1)	pH	Total Dissolved Solids (TDS)	Total Suspended Solids (TSS)	Nutrients	Cyanide (CN)	Metals (2)	Toxic Metals(3)	Chromium (Cr)	Oil and Grease	Phenol	Chlorinated Hydrocarbons	Ammonia Nitrogen	F. Coli.	Sulfide	BOD$_5$	COD	TOC	Other (4)
332	Iron & Steel Foundries	A	X	X	X			X	X	X	X									A
333-334	Non-Ferrous Smelters	A	X	X	X			X	X	X	X			X						F
335	Non-Ferrous Rolling	B		X	X			X	X	X	X									
336-339	Non-Ferrous Foundries	A	X	X	X			X	X	X	X									
34	Fabricated Metals	B	X	X	X			X			X							X		A
347	Coating, Engrav.	A	X	X	X		X	X	X	X										F, A
35	Machinery, Non-Elec.	B	X	X	X			X			X	X								
36	Machinery, Elec.	B	X	X	X		X	X	X	X										R
37	Transp. Equip.	C		X	X			X	X		X	X								
373	Ship Building	B		X	X			X	X	X	X	X	X							
38-39	Instruments Misc.	C																		
40-46	Transportation Services	C	X		X			X			X							X		S
493	Utility Companies	B	X	X	X						X		X							R
65	Commercial Buildings	C								X										T
721	Laundries	A	X	X	X	X					X		X		X		X		X	S, Alk

(continued)

TABLE A-1 (continued)

SIC Code	Industry Group	Rating (1)	pH	Total Dissolved Solids (TDS)	Total Suspended Solids (TSS)	Nutrients	Cyanide (CN)	Metals (2)	Toxic Metals(3)	Chromium (Cr)	Oil and Grease	Phenol	Chlorinated Hydrocarbons	Ammonia Nitrogen	F. Coli.	Sulfide	BOD_5	COD	TOC	Other (4)
739	Laboratories	A	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	F, R
75	Automotive Services	A	X	X	X	X					X						X	X		S

(1) A - Serious
B - Moderate
C - Slight

(2) Al, Co, Cu, Fe, Mg, Mn, Sr, Zn

(3) Sb, As, Ba, Co, Cd, Pb, Hg, Mo, Ni, Se, Ag, Sn, Ti, V

(4) A - Acidity
Alk - Alkalinity
B - Aromatic Hydrocarbons
C - Color
Cl - Chlorides
F - Fluorides
H - Hardness
K - Total Kjeldahl Nitrogen (TKN)
N - Nitrates Nitrogen
P - Phosphorous
R - Radioactivity
S - Surfactants
T - Temperature
X - Indicates substance is present in the effluent from a SIC group

TABLE A-2. ALLEGHENY COUNTY MUNICIPALITIES - PERCENT SEWERED

Municipality	% sewered	% ALCOSAN sewer service area
1. Aleppo Twp.	0	
2. Aspinwall	100	100
3. Avalon	100	100
4. Baldwin	100	90
5. Baldwin Twp.	100	100
6. Bell Acres	0	
7. Bellvue	100	100
8. Ben Avon	100	100
9. Ben Avon Heights	100	100
10. Bethel Park	100	50
11. Blawnox	100	100
12. Brackenridge	100	0
13. Braddock	100	100
14. Braddock Hills	100	100
15. Bradford Woods	0	
16. Brentwood	100	100
17. Bridgeville	100	100
18. Carnegie	100	100
19. Castle Shannon	100	100
20. Chalfont	100	100
21. Cheswick	100	0
22. Churchill	100	100
23. Clairton	100	0
24. Collier Twp.	50	50
25. Coraopolis	100	0
26. Crafton	100	100
27. Crescent Twp.	100	0
28. Dormont	100	100
29. Dravosburg	100	0
30. Duquesne	100	0
31. E. Deer Twp.	100	0
32. E. McKeesport	100	70
33. E. Pittsburgh	100	100
34. Edgewood	100	100
35. Edgeworth	60	0
36. Elizabeth	100	0
37. Elizabeth Twp.	30	0
38. Emsworth	100	100
39. Etna	100	100
40. Fawn Twp.	0	0
41. Findlay Twp.	40	0
42. Forest Hills	100	100
43. Forward Twp.	5	0

(continued)

TABLE A-2 (continued)

Municipality	% sewered	% ALCOSAN sewer service area
44. Fox Chapel	90	0
45. Franklin Park	20	15
46. Frazer	50	0
47. Glassport	100	0
48. Glenfield	0	0
49. Green Tree	100	100
50. Hampton	75	0
51. Harmar	100	0
52. Harrison	100	0
53. Haysville	100	0
54. Heidelberg	100	100
55. Homestead	100	100
56. Indiana Twp.	30	0
57. Ingram	100	100
58. Jefferson	80	0
59. Kennedy Twp.	100	100
60. Kilbuck Twp.	100	100
61. Leet Twp.	50	0
62. Leetsdale	95	0
63. Liberty	100	0
64. Lincoln	0	0
65. Marshall Twp.	5	0
66. McDonald	100	0
67. McKees Rocks	100	100
68. McKeesport	100	0
69. McCandless Twp.	95	25
70. Millvale	100	100
71. Monroeville	100	100
72. Moon Twp.	75	0
73. Mt. Lebanon Twp.	100	100
74. Mt. Oliver	100	100
75. Munhall	100	100
76. Neville Twp.	100	100
77. N. Braddock	100	100
78. N. Fayette Twp.	30	0
79. N. Versailles Twp.	100	20
80. O'Hara Twp.	100	100
81. Oakdale	100	0
82. Oakmont	100	0
83. Ohio	75	75
84. Osborne	100	0
85. Penn Hills Twp.	95	20
86. Pine Twp.	5	0

(continued)

TABLE A-2 (continued)

Municipality	% sewered	% ALCOSAN sewer service area
87. Pitcairn	100	100
88. Pittsburgh	100	100
89. Pleasant Hills	100	100
90. Plum	50	0
91. Port Vue	100	0
92. Rankin	100	100
93. Reserve Twp.	100	100
94. Richland Twp.	5	0
95. Robinson Twp.	100	10
96. Ross Twp.	100	100
97. Rosslyn Farms	100	100
98. Scott Twp.	100	100
99. Sewickley	100	0
100. Sewickley Heights	0	0
101. Sewickley Heights	0	0
102. Shaler Twp.	100	100
103. Sharpsburg	100	100
104. S. Fayette Twp.	10	0
105. S. Park Twp.	100	0
106. S. Versailles Twp.	0	0
107. Springdale	100	0
108. Springdale Twp.	100	0
109. Stowe Twp.	100	100
110. Swissvale	100	100
111. Tarentum	100	0
112. Thornburg	100	100
113. Trafford	100	100
114. Turtle Creek	100	100
115. Upper St. Clair Twp.	100	100
116. Verona	100	100
117. Versailles	100	0
118. Wall	100	100
119. W. Deer Twp.	15	0
120. W. Elizabeth	0	0
121. W. Homestead	100	100
122. W. Mifflin	85	20
123. West View	100	100
124. Whitaker	100	100
125. White Oak	100	0
126. Whitehall	100	100
127. Wilkins Twp.	100	100
128. Wilkinsburg	100	100
129. Wilmerding	100	100

TABLE A-3. ALLEGHENY COUNTY MUNICIPALITIES LESS THAN 75% SEWERED

1.	Aleppo Twp.	0%
2.	Bell Acres	0%
3.	Bradford Woods	0%
4.	Collier	50%
5.	Edgeworth	60%
6.	Elizabeth Twp.	30%
7.	Fawn Twp.	0%
8.	Findlay Twp.	40%
9.	Forward	5%
10.	Franklin Park	20%
11.	Frazer Twp.	50%
12.	Glenfield	0%
13.	Indiana Twp.	30%
14.	Leet Twp.	50%
15.	Lincoln	0%
16.	Marshall Twp.	5%
17.	N. Fayette Twp.	30%
18.	Pine Twp.	5%
19.	Plum	50%
20.	Richland Twp.	5%
21.	Sewickley Heights	0%
22.	Sewickley Hills	0%
23.	S. Fayette Twp.	10%
24.	S. Versailles Twp.	0%
25.	W. Deer Twp.	15%
26.	W. Elizabeth	0%

APPENDIX B

TELEPHONE SURVEY SUMMARIZATION

All major industries (significant* Standard Industrial Codes and/or greater than 500 employees) in the county were sent introductory letters and then contacted by telephone to gain actual data on residue generation and disposal. Data obtained in the survey was entered into the computerized data base and utilized to extrapolate values for other industries within the SIC code. The following is a summarization of industries contacted and results.

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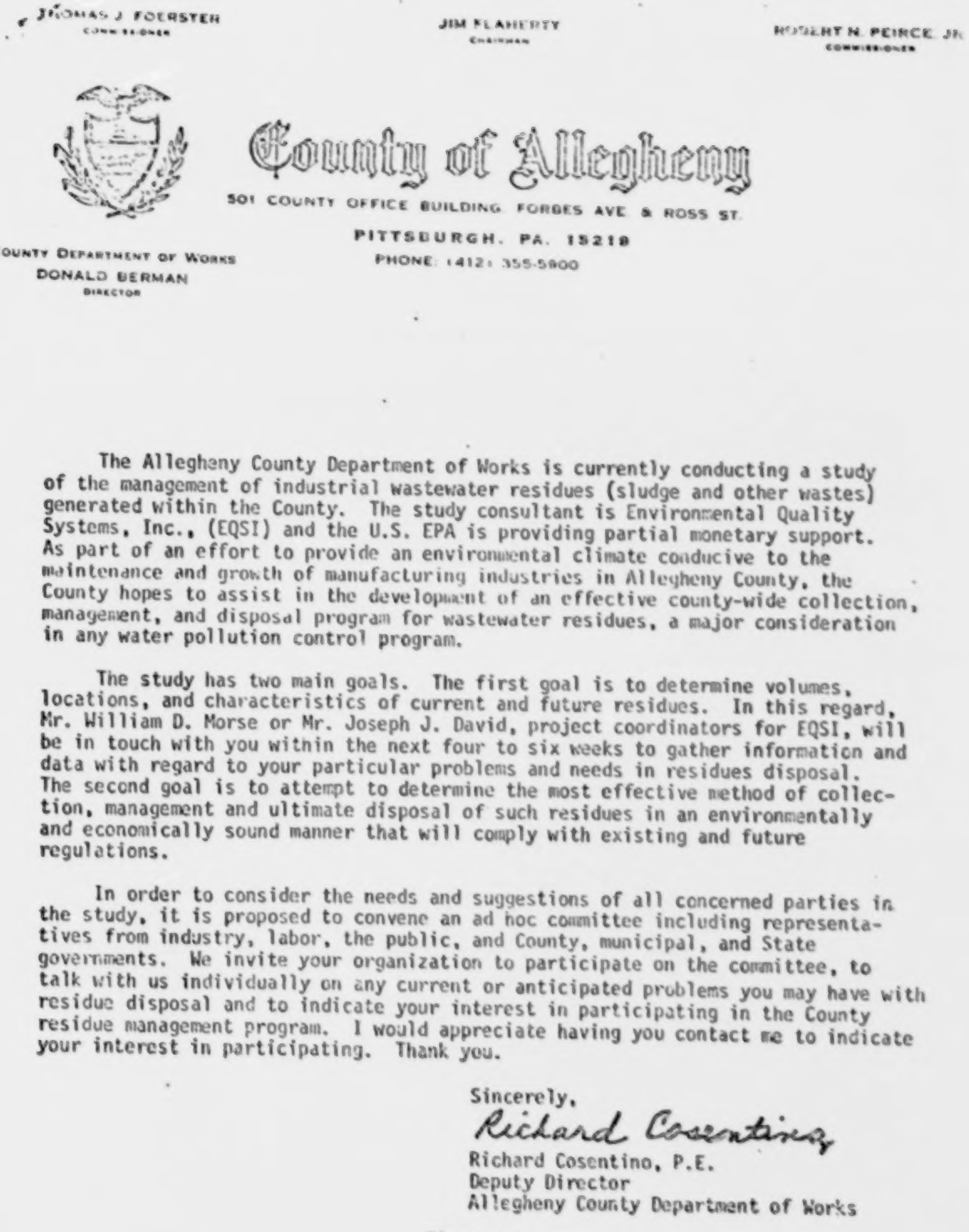
*As defined in Appendix A.



THOMAS J. FOERSTER
COMMISSIONER

JIM FLAHERTY
CHAIRMAN

ROBERT N. PEIRCE, JR.
COMMISSIONER

County of Allegheny
501 COUNTY OFFICE BUILDING, FORBES AVE. & ROSS ST.
PITTSBURGH, PA. 15219
PHONE: (412) 355-5800

COUNTY DEPARTMENT OF WORKS
DONALD BERMAN
DIRECTOR

The Allegheny County Department of Works is currently conducting a study of the management of industrial wastewater residues (sludge and other wastes) generated within the County. The study consultant is Environmental Quality Systems, Inc., (EQSI) and the U.S. EPA is providing partial monetary support. As part of an effort to provide an environmental climate conducive to the maintenance and growth of manufacturing industries in Allegheny County, the County hopes to assist in the development of an effective county-wide collection, management, and disposal program for wastewater residues, a major consideration in any water pollution control program.

The study has two main goals. The first goal is to determine volumes, locations, and characteristics of current and future residues. In this regard, Mr. William D. Morse or Mr. Joseph J. David, project coordinators for EQSI, will be in touch with you within the next four to six weeks to gather information and data with regard to your particular problems and needs in residues disposal. The second goal is to attempt to determine the most effective method of collection, management and ultimate disposal of such residues in an environmentally and economically sound manner that will comply with existing and future regulations.

In order to consider the needs and suggestions of all concerned parties in the study, it is proposed to convene an ad hoc committee including representatives from industry, labor, the public, and County, municipal, and State governments. We invite your organization to participate on the committee, to talk with us individually on any current or anticipated problems you may have with residue disposal and to indicate your interest in participating in the County residue management program. I would appreciate having you contact me to indicate your interest in participating. Thank you.

Sincerely,

Richard Cosentino

Richard Cosentino, P.E.
Deputy Director
Allegheny County Department of Works

Figure B-1

TYPING GUIDE SHEET
BEGIN FIRST LINE OF TEXT HERE
TOP OF IMAGE AREA
DROPPED HEAD BEGIN SECTIONS HERE

Company: ______________________________

SIC: __________ Employment: __________

Production: product current amt. 1985 amt.

1. ______________________________

2. ______________________________

3. ______________________________

Wastewater treatment or pre-treatment:

Current/BPTCA: ______________________________

BATEA: ______________________________

Volume: ______________________________

Discharge points: ______________________________

Residue generation: type (% sol) amount disposal

WW treat: 1. ______________________________

2. ______________________________

3. ______________________________

Process: 1. ______________________________

2. ______________________________

Air pol: 1. ______________________________

Residue management:

Treatment: ______________________________

Storage/treat. capacity: ______________________________

Ultimate disposal: ______________________________

Costs: ______________________________

Comments: ______________________________

____

Figure B-2. Industrial Residue Survey.

BOTTOM OF IMAGE AREA; OUTSIDE DIMENSION FOR TABLES AND ILLUSTRATIONS
BEGIN LAST LINE OF TEXT

PAGE NUMBER

TABLE B-1. INDUSTRIAL SUMMARIZATION BY STANDARD INDUSTRIAL CLASSIFICATION (SIC)

SIC	Name	Number of industries	Employees (total)
1211	Coal Preparation	5	357
2011	Meat Packing	4	612
2022	Cheese	1	7
2032	Canned Food	1	1796
2051	Bakeries	2	1396
2077	Fats and Oils	2	62
2082	Breweries	1	537
2086	Bottlers	1	10
2098	Macaroni	1	102
2258	Fabric Mills	1	28
2269	Textile Finishers	1	41
2391	Curtains	1	84
2641	Paper Coating	1	614
2643	Bags	1	143
2653	Boxes	1	396
2711	Newspapers	1	1769
2752	Lithographers	3	532
2813	Industrial Gases	4	58
2816	Inorganic Pigment	1	55
2819	Industrial Inorganic Chemicals	5	118
2821	Plastics, Synthetics	5	1133
2834	Pharmaceuticals	3	257
2844	Cosmetics, Toiletries	1	57
2851	Paints, Varnishes	14	1133
2869	Industrial Organic Chemicals	2	498
2891	Adhesives, Sealants	3	112
2893	Printing Ink	2	32
2899	Other Chemicals	6	229
2951	Paving Mix	4	25
2952	Asphalt	1	100
2992	Lube Oils	5	223
2999	Coal, Petroleum Products	1	30
3079	Plastics	9	1351
3211	Flat Glass	1	152
3221	Glass Containers	1	400
3229	Pressed Glass	2	348
3231	Glass Products	3	1254
3241	Cement	2	268
3251	Brick	1	58
3255	Clay Refractory	1	51

(continued)

TABLE B-1 (continued)

SIC	Name	Number of industries	Employees (total)
3272	Concrete	2	57
3273	Concrete - ready mix	1	73
3281	Cut Stone	2	12
3291	Abrasive Products	2	74
3295	Treated Minerals	1	79
3312	Iron, Steel, Rolling	13	40923
3315	Steel Wire Drawing	1	17
3316	Cold Rolled Steel	1	450
3317	Steel Pipe	1	43
3321	Gray Iron Foundries	5	1219
3325	Steel Foundries	6	2385
3339	Primary Non-Ferrous Smelting	1	38
3341	Secondary Non-Ferrous Smelting	5	263
3351	Copper Rolling	2	920
3356	Other Non-Ferrous Rolling	1	12
3361	Aluminum Foundries	3	73
3362	Copper Alloy Foundries	11	503
3399	Other Metal Products	5	314
3411	Metal Cans	1	500
3412	Metal Barrels	3	168
3423	Tools	1	130
3432	Plumbing Fixtures	1	223
3433	Heating Equipment	1	34
3441	Fabricated Structural Metal	6	2192
3443	Boiler Shops	5	1869
3444	Sheet Metal Work	1	168
3446	Architectural Metal	1	600
3452	Bolts, Nuts, Screws	3	369
3462	Iron and Steel Forgings	7	2507
3465	Automotive Stampings	1	1490
3471	Platers	14	320
3479	Coating, Engraving	15	627
3484	Small Arms	1	45
3493	Steel Springs	3	617
3494	Valves, Pipe Fittings	5	1232
3498	Fabricated Pipe	1	20
3499	Other Fabricated Metal	1	105
3511	Turbines	1	7133
3544	Dies and Tools	3	149
3545	Machine Tool Accessories	5	978
3547	Rolling Mill Equipment	1	2220
3555	Printing Equipment	1	493
3561	Pumps	1	1104
3563	Compressors	2	625
3566	Speed Changers, Gears	1	103
3567	Furnaces	2	1652

(continued)

TABLE B-1 (continued)

SIC	Name	Number of industries	Employees (total)
3573	Computers	1	747
3599	Other Non-Electric Machinery	2	99
3613	Switch Gear	2	3714
3621	Motors, Generators	2	168
3622	Industrial Controls	1	148
3629	Electrical Industrial Equipment	1	250
3662	Transmitters, Signalers	2	1361
3679	Electronic Components	2	72
3694	Engine Electronic Equipment	1	51
3731	Ship Building	1	1954
3743	Railroad Equipment	2	3392
3829	Measuring Devices	1	362
3842	Surgical Appliances	1	1609
3953	Marking Devices	1	225
3955	Carbon, Inked Paper	1	175
4011	Railroad Services	8	1459
4231	Motor Freight Terminal	1	*
4463	Marine Cargo	1	50
4582	Airports	1	290
4583	Airport Terminals	1	*
4911	Electric Services	5	*
4941	Water Supply	36	*
4952	Sewerage Systems	36	*
4961	Steam Supply	2	34
5171	Petroleum Bulk Stations	8	245
7215	Laundries	2	*
7391	R&D Laboratories	11	12069
7538	Automotive Services	1	50
7542	Car Washes	4	35
		392	**

* Not available

** Total Allegheny County employment is 120,200.

TABLE B-2. TELEPHONE SURVEY SUMMARIZATION

SIC	No. contacted	Employment	Residue Types Reported: Water pollution control	Residue Types Reported: Air pollution control	Residue Types Reported: Process residues
1211 Coal Preparation	5	350	5		
2011 Meat Packing Plants	1				
2032 Canned Food	1	1800			
2051 Bakeries	2	1350			1
2052 Bakeries	1	1000	1		
2082 Malt Beverages	1	537			
2641 Paper Coating	1	614			1
2653 Boxes	1	300	1		1
2711 Newspapers	1	1770			1
2751 Commercial Print	1	60			
2752 Commercial Print	2	440			
2791 Typesetting	1	29			
2813 Industrial gases	1	15			1
2816 Inorganic pigments	1	55	1		1
2819 Industrial inorganic chem.	1	8			
2821 Plastics, syn.	3	860	1		2
2834 Pharmaceuticals	1	100			
2851 Paints	4	1075	2	1	3
2891 Adhesives, sealants	1	45	1		1
2893 Printing Ink	1	23			1
2899 Other Chemicals	3	220	1		
2951 Paving Mixtures and blocks	2	110			
2992 Lubricating Oils	1	100	1		
3079 Plastics	1	626			
3221 Glass Containers	1	420	1		
3241 Cement	1	94			1
3295 Treated Minerals	1	79			
3231 Glass Prod.	2	1184	1		1
3312 Iron, Steel rolling	12	38,500	11	11	10
3316 Cold, Rolled steel	1	450	1		1
3321 Gray iron foundries	2	620	1		1
3325 Steel Found.	5	2330		3	4
3339 Primary non-ferrous smelt.	1	80			1

(continued)

TABLE B-2 (continued)

SIC		No. contacted	Employment	Residue Types Reported		
				Water pollution control	Air pollution control	Process residues
3341	Secondary nonferrous smelting	1	150			1
3351	Copper rolling	2	920	1		1
3362	Copper alloy foundries	1	180		1	1
3399	Primary metal products, nec	1	71			
3411	Metal cans	1	500			1
3423	Tools	1	130		1	
3441	Fabricated struc. metal	2	600			1
3443	Boiler Shops	3	1800		1	
3444	Sheet Metal wk	1	170			
3446	Architectural work	1	600			
3452	Bolts, nuts, screws	1	300	1		1
3462	Iron and steel forgings	2	1700			
3465	Automotive stampings	1	1000	1		
3471	Platers	5	270	3		3
3479	Coating, engrav.	5	320			2
3493	Steel springs	1	350			
3511	Turbines	1	10,000			
3547	Rolling mill equipment	1	2220		1	1
3561	Pumps	1	1000			
3563	Air and gas compressors	1	370		1	
3567	Furnaces	1	1400			
3573	Computers	1	760			
3613	Switchgear and switchboard app.	2	3710			
3662	Transmitters, signallers	1	1200			
3621	Motors and generators	1	72			
3731	Shipbuilding	1	1400			
3743	Railroad equip.	1	2700			
3829	Measuring devices	1	375			1
3842	Surgical appliances	1	1600			
		103	89,000	33	22	45

APPENDIX C

RESIDUE GENERATION PER UNIT PRODUCTION

TABLE C-1. INDUSTRIAL PRODUCTION PER EMPLOYEE BY SIC*

SIC	Title	Production/employee/day
1211	Coal Preparation	6.0 kkg
2011	Meat Packing	0.137 kkg (0.56 kkg RM)**
2022	Cheese	0.12 kkg (2.0 kkg RM)**
2032	Canned and Preserved Fruits & Vegetables	1800 cans (8 oz. cans)
2051	Bakeries	0.096 kkg
2077	Fats and Oils	1.8 kkg (2.1 kkg RM)**
2082	Breweries	1.1 kl
2086	Bottling	0.59 kl
2258	Fabric Mills	0.18 kkg
2269	Textile Finishers	0.18 kkg
2653	Boxes	0.45 kkg
2816	Inorganic Pigments	0.54 kkg
2821	Plastics, Synthetics	.70 kkg
2851	Paints	0.171 kl
2869	Organic Coatings	1.20 kkg
2893	Printing Ink	0.040 kl
2951	Asphalt Paving	54 kkg
2952	Asphalt Coatings	0.87 kl
2992	Lubricating Oils	2.3 kl
3079	Plastics	0.024 kkg
3211	Flat Glass	0.55 kkg
3221	Glass Containers	0.45 kkg
3229	Pressed and Blown Glass	0.16 kkg
3231	Glass Products	0.071 kkg
3241	Cement	5.6 kkg
3255	Clay Refractories	1.61 kkg
3272	Concrete	3.4 kkg
3273	Concrete - Ready Mix	18.2 kkg
3291	Abrasive Products	0.88 kkg
3292	Asbestos	0.31 kkg
3295	Treated Minerals	61.5 kkg
3315	Steel Wire Drawing	0.74 kkg
3316	Cold Rolled Steel	0.17
3317	Steel Pipe	0.15 kkg
3321	Gray Iron Foundries	0.53 kkg
3325	Steel Foundries	0.18 kkg
3339	Primary Non-Ferrous Smelting	1.3 kkg
3341	Secondary Non-Ferrous Smelting	1.8 kkg
3351	Copper Rolling	0.19 kkg
3356	Other Non-Ferrous Rolling	0.031 kkg

(continued)

TABLE C-1 (continued)

SIC	Title	Production/employee/day
3361	Aluminum Foundries	0.32 kkg
3362	Copper Alloy Foundries	0.018 kkg
3399	Other Metal Products	0.19 kkg
3411	Metal Cans	3100 cans
3412	Metal Barrels	4.7 barrels
3423	Tools	0.024 kkg
3432	Plumbing Fixtures	0.025 kkg
3433	Heating Equipment	0.050 kkg
3441	Fabricated Structural Metal	0.15 kkg
3443	Boiler Shops	0.094 kkg
3444	Sheet Metal Work	0.084 kkg
3446	Architectural Work	0.045 kkg
3452	Bolts, Nuts, Screws	0.073 kkg
3462	Iron and Steel Forgings	0.14 kkg
3465	Automotive Stampings	0.26 kkg
3471	Platers	0.30 kkg
3479	Coating, Engraving	0.46 kkg
3484	Small Arms	0.0067 kkg
3493	Steel Springs	0.19 kkg
3494	Valves, Pipe Fittings	0.022 kkg
3498	Fabricated Pipe	0.070 kkg
3499	Other Fabricated Metal	0.050 kkg
3544	Dies and Tools	0.0089 kkg
3545	Machine Tool Accessories	0.0019 kkg
3547	Rolling Mill Equipment	0.095 kkg
3566	Speed Changers, Gears	0.026 kkg
3567	Furnaces	0.0025 units (.0087 kkg)
3586	Measuring Pumps	1.53 units
3599	Other Non-Electrical Machinery	0.011 kkg
3613	Switchboard Apparatus	0.016 kkg
3621	Motors, Generators	0.040 kkg
3622	Industrial Controls	0.0071 kkg
3662	Transmitters, Signallers	0.0016 kkg
3694	Engine Electrical Equipment	0.105 kkg
3731	Ship Building	0.00034 ship
3743	Railroad Equipment	0.085 kkg
3829	Measuring Devices	0.0013 kkg
4961	Steam Supply	55 kkg

*These values represent 1977 data.

**RM - Raw materials

TABLE C-2. RESIDUE GENERATION PER UNIT OF PRODUCT PRODUCED

SIC	Name	Subcategory	Class	% Solids	Residue Generated (kg Residue/kkg product) BPTCA	BATEA	Pretreat.	Process
1211	Coal	Non-recovery	C3	40	73	73		
		D. air flotation	C3	40	31	31		
		AMD Treatment	D1	2	830	830**		
201	Meat	Dissolved Air Flotat.	C1	5	35 (28.0-420)	37.0 (32.0-420)		
		Biological treat.	C1	5	55.5 (7.0-104)	56.0 (8.0-104)	-	
			A5	100	4.0	4.0	4.0	
2022	Cheese		C1	2	65.8 (4.7-127)	69 (4.9-133)	0.0	9000 (Whey)
203	Canning		C1	5	160	178	0.0	
205	Bakeries		C1	5	.349*	.349*	0.0	
2077	Animal Fats	Diss. Air flotation	C1	3.5	326	326	.40(O&G)	
		Activated sludge	C1	3.5	407	407	.40(O&G)	
		Extended aerat.	C1	3.5	163	163	.40(O&G)	
		Anaerobic contact	C1	3.5	65.2	65.2	.40(O&G)	
2082	Beer	(per kl)	C1	5	226	226	0.0	
2086	Bottler	Bottlers(per kl)	C1	5	11.4	11.9	0.0	
		Canners	C1	5	25.7	28.2	0.0	

(continued)

* kg/employee/day
** per 1000 gal. treated

TABLE C-2 (continued)

SIC	Name	Subcategory	Class	% Solids	Residue Generated BPTCA	BATEA	(kg residue/ kkg product) Pretreat	Process
209	Misc. Food		C1				0.0	
225	Knitting		F5	5	1120	1452	0.0	
226	Tex. finish		F5	5	86	142	0.0	
239	Textiles		F5	5	4.3	7.2	0.0	80
264	Paper Prod.		C5 F4 B9	5	.11*	.11*		
271	News-papers		A2 F4		.09* .10*	.09* .10*	0.0 0.0	
275	Print-ing	Flat-bed, offset, screen	B4		.09*	.09*	0.0	
		Flexography, rot. letter-press, gravure	B4		.09*	.09*	.09*+	
2813	Ind. Gases	Oxygen, nitrogen	A2	100	.01	.01	0.0	
2816	Inorg. Pigment	TiO_2 Other	B1 F5	100	5000 34	5000 34	5000 34	

(continued)

* kg/employee/day
+ Applies to industries established after November 1, 1974.

TABLE C-2 (continued)

SIC	Name	Subcategory	Class	% Solids	Residue Generated BPTCA	BATEA	(kg Residue/kkg product) Pretreat	Process
2819	Inorg. Chem		F5					
2819	Inorg. Chem	NaCl (re-used) DS	F5	100		150	150	
		$NaCO_3$ DS	F5	100		1320	1320	
		SS	F5	100		90	90	
		NaOH DS	F5	100		137	137	
		SS	F5	100		13	13	
		$Na_2Cr_2O_7$ DS	F5	100		11	11	
		SS	F5	100		47	47	
		$NaSiO_2$ DS	F5	100		5.0	5.0	
		SS	F5	100		2.5	2.5	
		Na DS	F5	100		146	146	
		SS	F5	100		4.5	4.5	
		$Al_2(SO_4)_3$ SS	F5	100		3.5	3.5	
		H_2SO_4 (reused) DS	F5	100		0.5	0.5	1.5 part
		HNO_3 DS	F5	100		0.2	0.2	
		SS	F5	100		0.05	0.05	
		H_2O_2 DS	F5	100		20	20	
		HF (reused) SS	F5	100		3.6	3.6	
		Misc. DS	F5	100		1.25	1.25	
		SS	F5	100		0.6	0.6	
		P_2O_5 Wet	F5	100				20 (F)
		Thermal	F5	100				67 (part)
2821	Plastic, Synth.		F3	100	9.9	9.9	9.9	3.75 (part)
		Cellulose base	F3	35	71-142	71-142	71-142	
		Phenolics; epoxy, nylon polyesters, acrylic	F3	35	29-71	29-71	29-71	

(continued)

TABLE C-2 (continued)

SIC	Name	Subcategory	Class	% Solids	Residue Generated BPTCA	BATEA	(kg Residue/kkg products) Pretreat.	Process
2821	Plastic, synth. (continued)	Polystyrene, PVC, ABS-SIN	F3 F2	35	2.9-29	2.9-29	2.9-29	
		polyethelene, polypropylene	B2					
		Resins (cumol, indine)	F3	5	52	52	52	
2834	Drugs		C2					
2844	Toiletries		C2					
2851	Paint	Water base	D9		110			5.9(paint)
		Solvent base	B1		110			8.3(paint)
		(spent cleaning solv)	B1					82(solv.)
286	Org. chem.		F3					
2865	Cyclic Prod.	(BOD)	C9	5	116	121	116	
		resins	B2		2.8	2.8	2.8	
2869	Org. Chem.	Maleic anhydride	F3		130	131	130	
		Pthalic anhydride	F3					
		O-Xylene	F3		.052	.058	.052	21
		Napthalene	F3		53.5	53.5	53.5	21
2891	Adhesives		E9		14*	14*	14*	
		Coatings, varnishes (cleaning)	F2					

(continued)

* kg/employee/day

TYPING GUIDE SHEET

TABLE C-2 (continued)

SIC	Name	Subcategory	Class	% Solids	Residue Generated BPTCA	BATEA	(kg residue/kkg products) Pretreat.	Process
2893	Printing Ink		F4		0.0		0.0	
		Waste ink	F4					.83
2899	Misc. Chem.	Water treatment chem.	F9		0.0	0.0	0.0	
		Ceramics, enamels	B1		7.5	7.5	7.5	
2951	Paving	Asphalt concrete	F3	5	34.7	34.7		
2952	Asphalt		F3	5	13.0	13.0		
2992	Lube Oils		A1	100	.037*	.037*		
2999	Coal Products		F3	100	3.7	3.7	0.0	
3079	Plastics		C5	5	1.8*	1.8*		
			A1	100	.80*	.80*		
3211	Flat glass	Plate	E5		13800	13800		
		Float	E5		.04	.04		
		Rolled	E5		0.0	0.0		
		Sheet	E5					
3221	Glass cont.	Dissolved air float.	A1	3	0.0	3.30	0.0	
		Diatom. earth filt.	E5	15	0.0	1.06	0.0	
		Cullet	E5	.63	.63	.63	.63	

(continued)

* kg/employee/day

EPA-287 (Cin.)
(4-76)

TABLE C-2 (continued)

SIC	Name	Subcategory	Class	% Solids	Residue Generated BPTCA	(kg residue/kkg product) BATEA	Pretreat.	Process
3312	Iron, Steel	A. Coke Biological	F6	7	5.7	6.4	5.7	
		Neutralization	F6	10	1.7	9.0	1.7	
		(BAT-add carb)	F7					0.95
		Advanced (incin/bio)	F6	60		2.3		
		B. Sintering	D5	100	1.8	1.8	1.8	
		C. Blast Fur.	D6	40	38.8	58.8	38.8	
		(BAT adds neut,carb)	E2	100				200 (slag)
		Ferro-	D6	25	640	800	640	
		manganese	E2	100				200 (slag)
		D. BOF Wet	D6	35	38	38	38	
		(hi value for Zn res)**			(25.7-51.4)	(25.7-51.4)		
		Semi-wet	D6	50	.90	.90	.90	
			E3	100				100 (slag)
		E. Open Hearth	D6	45	20.1	20.1	20.1	
		(BAT add lime precip. F, Zn)	D6	10		3.1		
			E3	100				100 (slag)
		F. Electric Furnace-wet	D6	40	28.8	28.8	28.8	
		(BAT add lime neut)	D6	10		.20		
		Dry	D7	100				13
			E3	100				100 (slag)

**Sludge containing Zn cannot be recycled to sinter.

(continued)

TABLE C-2 (continued)

SIC	Name	Subcategory	Class	% Solids	Residue Generated (kg residue/kkg products) BPTCA	BATEA	Pretreat.	Process
3229	Press glass	Tubing	E5	15	0.0	4.5		
		Hand pressed, blown SS	E5	15	143	149		
		CaF_2	E5	15	46.9			
3231	Glass prod.	Tempering - coag.	E5	20	1.4-3.0			
		Lamination - diatom.	E5	15	7.0	7.0		
		Recycle (salt brine)	E5	15	19.0	19.0		
324	Cement	Leaching	E6	100	23.3	35.9		111-179
		$CaSO_4$	E6	100	16.2	18.1		
		Non-leaching	E6	100	1.74	1.74		111-179
3251	Brick		E6	40	7.5	7.5		38 (dry)
3255	Refractories		E6	40	.313	.313		10 (dry)
327	Concrete prod.		E6	80	3%of prod.	3% of prod.		
328	Cut stone		E1					
3291	Abrasives		E1					
3292	Asbestos		E1	100	94.0	99.4	94.0	254 (dry asb.)
3295	Mineral prod.		E1					

(continued)

Table C-2 (continued)

SIC	Name	Subcategory	Class	% Solids	Residue Generated BPTCA	(kg residue/kkg product) BATEA	Pretreat.	Process
3312 cont.	Iron, steel	G. Vacuum degassing (BAT lime neut)	D7	20	0.0	.30	0.0	
		H. Cont. casting	D7 A4	35 100	2.42 .53	2.42 .53	2.42 .53	
		I. Hot rolling-primary	D7 A6	40 100	0.0 .35	3.0 .40	3.0 .35	
		J. Hot rolling-secondary O&G	D7 A6	40 100	9.6 1.13	11.9 1.58	1.13	
		K. Pipes & tubes-hot	D7	70	.78	1.30	.78	
		-cold	D7	40	1.35	1.35	1.35	
		L. Pickling-H_2SO_4	D1					
		(spent) neutralization	D1	2	360	360	360	
		regeneration	D9	100				
		H_2SO_4 (rinse)	D1	2	75	78	75	
		HCl (spent)	D1	40	66.2	66.2	66.2	
		neutralization	D1	2	459	459	459	
		regeneration	D9	2	120	123	120	

(continued)

TABLE C-2 (continued)

SIC	Name	Subcategory	Class	% Solids	Residue Generated BPTCA	BATEA	(kg residue/kkg product) Pretreat.	Process
		HCl(rinse)	D1	60	4.0	4.1	4.0	
		HNO_3 (spent)	D1	2	407	407	407	
		HNO_3 (rinse)	D1	2	175	175	175	

(continued)

TABLE C-2 (continued)

SIC	Name	Subcategory	Class	% Solids	Residue Generated BPTCA	BATEA	(kg residue/kkg product) Pretreat.	Process
3312 cont.	Iron, steel	Untreated spent acid H_2SO_4	D3		67	67		
		HCl	D4		57	57		
		M. Coating-Hot	D2	3	21.6	23.3	21.6	
			A1	100	.10	.11	.10	
		-Cold	D2	3	48.3	51.6	48.3	
			A1	100	0.15	0.18	0.15	
3315	Wire	Pickling	D2	2	125	125	125	
		Drawing solution	A9	100	0.46	0.46	0	
3316	Cold Roll	Direct	D7	40	1.65	1.75	1.65	
			A4	100	1.50	1.55	1.50	
		Recycle	D7	40	.88	.88	.88	
			A4	100	3.0	3.0	3.0	
3317	Pipe	Hot	D7	70	.78	1.30	0.78	
		Cold	D7	40	1.35	1.35	1.35	
3321	Iron foundry	Air pollut. con.partic.	D8	100	5.7	6.3	6.3	
		Scrap sand	E1		71	71	78	
		Slag	E2		200	200	200	

(continued)

TABLE C-2 (continued)

SIC	Name	Subcategory	Class	% Solids	Residue Generated BPTCA	BATEA	(kg residue/kkg product) Pretreat.	Process
3325	Steel foundry	Baghouse	D8	100	19	24	24	
		Scrap sand	E1	100	94	94	94	
		Slag	E3	100				100
3339	Non-Fe Smelters (primary)	Aluminum	D9	30	39	39	39	
		Other metals	D5	5				
3341	Non-Fe Smelters (secondary)	Copper	D6	40	310	310	310	
		Lead	D5	40	5.5	5.5	5.5	
		Zinc SS	D6	40	1.3	1.4	1.4	
		Zn	D6	40	2.6	2.6	2.6	
		Aluminum	D5		6.7	6.7	6.7	
		Tin	F2	2	32	31	31	
			A4					
335	Non-Fe roll	Copper	D1	5	650	650		
			D3		104	104	104	
336	Non-Fe found.	Cooling	D6	40	.15*	.15*	.15*	
		Baghouse	D8	100	83	83		
		Foundry sand	E1	100	166	166	166	
339	Other metals	Scrubber	D6		4.4*	4.4*		
341	Containers	Lithographing	B4		.83*	.83*	.83*	
			A2	100	.06*	.06*	.06*	
342	Tools met.	Baghouse	D5	100	1.7	1.7	1.7	
		Cleaning	D7					
343	Fixtures	Plating	D1	2				
		Cleaning	D7	5				

* kkg/employee/day

(continued)

TABLE C-2 (continued)

SIC	Name	Subcategory	Class	% Solids	Residue Generated BPTCA	(kg residue/kkg product) BATEA	Pretreat.	Process
344	Struc. metal	Cleaning (Dry cleaning ofted used)	D7	5	1.24*	1.24*	0.0	
			A1	100	.032*	.032*	0.0	
			B3					
345	Bolts	Metal cleaning	D6	40				
		Spent pickle liquor	D3		118	118	118	
		Cutting oil	A6	100	4.4	4.4	4.4	
346	Forging	Metal cleaning	D7	40	3.6	3.6	0.0	
			A1	100	.22	.22		
		Pickling	D3					
3471	Electro-Plating	(.26% Cu, .23% Cr, .29 Ni, .45 Zn)	D1	2	17.5*	19.0*	17.5*	
		Coil coating (per 10^3 ft^2)	B3	5	.21	.21	.21	
			D3		67	67	67	
3479	Coating	Lithographing	B1		54*	54*	54*	
			D3		67	67	67	
348	Small Arms	Metal cleaning	D7	40				
349	Misc. fab.	Metal cleaning	D7	40	.21*	.21*	0.0	
		Cleaning	A1	100	.05*	.05*	0.0	
		Plating	D1	2				

* kkg/employee/day

(continued)

TABLE C-2 (continued)

SIC	Name	Subcategory	Class	% Solids	Residue Generated BPTCA	BATEA	(kg residue/kkg product) Pretreat.	Process
351	Turbines	Metal cleaning	D7	40				
354	Metal-work mach.	Metal cleaning	D7	40	.019*	.019*		
			A1	100	.008*	.008*		
		Plating	D1	2				
355	Mach.	Metal cleaning	D7	40				
356	Gen. mach.	Metal cleaning	D7	40	.028		0.0	
		Oil	A1	100	.006*		0.0	
		Plating, pickling	D1	7	27.3	27.3	27.3	
357	Computers	Metal cleaning (solv) plating	B3	5				
358-9	Misc. mach.	Metal cleaning (solv)	B3	5				
361	Switch gear	Metal cleaning	D7	40				
		plating	D1	2				
362	Motors	Metal cleaning	D7	40	small		0.0	
		plating	D1	2				

(continued)

* kkg/employee/day

TABLE C-2 (continued)

SIC	Name	Subcategory	Class	% Solids	Residue Generated (kg residue/kkg product) BPTCA	BATEA	Pretreat.	Process
366	Transmitters	Metal cleaning plating	D1	2				
367-9	Elec. comp.	Metal cleaning, plating	D1	2				
373-4	Transp. equip.	Shop cleaning	C9	5				
		Metal cleaning	D7	40				
382-4	Instruments	Metal cleaning, plating	D1	2				
3955	Carbon paper							
4011	RR service	Locomotive maint.	C5	5	16.9^{+}	17.0^{+}		
		(3300 l/unit)	A1	100	3.5^{+}	3.5^{+}		
		Car washing	C5	5	73.8^{+}	75.4^{+}		
		(6300 l/unit)	A1	100	3.6^{+}	3.7^{+}		
422-3	Motor service		C5					
446	Marine service		C5					
458	Air service		C5					

(continued)

$^{+}$ kg/unit/day

TABLE C-2 (continued)

SIC	Name	Subcategory	Class	% Solids	Residue Generated BPTCA	BATEA	(kg residue/kkg product) Pretreat.	Process
4911	Power	75% Capac. cool - 11% ash, 3% S, 11,000 BTU/lb: Fly ash	E4	100	900/MW cap.	900/MW cap.		
		SO_2 scrubber (stabiliz)	E8	51	1100/MW cap.	1100/MW cap.		
4941	Water Supply	Filter Backwash	E7	5	2040**	2040**		
		Coag. Sludge	E7	5	9460**	9460**		
		Softening (per 100 mg/l of hardness removed)	E7	5	23,360**	23,360**		
4952	Municipal WWT	Primary	C4	20	2270	2270		
		Secondary						
		Act. Sludge	C4	20	1590	1590		
		Trickling Filter	C4	20	1480	1480		
		Tertiary (Chemical Nutrient Removal)	C4	20	-	5430		
496	Steam supply		E8	51				
5171	Petrol. bulk Stations		A1					
7215	Laundries		C5					

(continued)

TABLE C-2 (continued)

SIC	Name	Subcategory	Class	% Solids	Residue Generated BPTCA	BATEA	(kg residue/kkg product) Pretreat.	Process
7391	R&D Labs		F9 F4 D9					
7536	Auto Service		A1					
7542	Car wash.		C5					

KEY TO ITEMS APPEARING IN APPENDIX C

MAD treatment - acid mine drainage treatment

BATEA (BAT) - best available technology economically achievable

BOD - biochemical oxygen demand (in specific, BOD_5, or BOD measured at 5 days)

BOF - basic oxygen furnace

BPTCA (BPT) - best practicable technology currently available

Diatom. earth filt. - diatomaceous earth filtration

(incin/bio) - incineration/biological waste treatment

kkg - kilokilogram = 1 metric ton = 2205 pounds

lime precip., F, Zn - precipitation with lime for treatment of Fluoride and Zinc.

misc. - miscellaneous

O & G - oil and grease

SS - suspended solids

TDS - total dissolved solids

APPENDIX D

INDUSTRIAL RAW WASTEWATER CHARACTERISTICS

TABLE D-1. RAW WASTEWATER CHARACTERISTICS

SIC	Title, comments	Parameter	Low	High	Average value	Units
2011	Red Meat Processing	Flow	3106	16000	8300	l/kkg LWK
	Segm. of Meat Product and	BOD_5	3.8	20	10	kg/kkg LWK
	Rendering Processing (LWK=	SS	1.4	18	7.9	"
	live weight killed)	Grease	1.1	14.6	5.0	"
	(values are avgs. over	Kjel N	0.26	1.9	0.80	"
	four categories)	Cl^-	0.53	14	6.1	"
		Tot P	0.074	0.59	0.30	"
	Ratio of processed	Flow			3300	kl/day
	products/kill = 0.14	BOD_5			1300	mg/l
	(0.016-0.362) for low	SS			1000	"
	processing packinghouse,	Grease			630	"
	=0.65 (0.4-2.14) for high	Kjel N			92	"
	processing packinghouse	Cl^-			690	"
	Avg. conc. for plant with 400 kkg/day LWK	Tot P			37	"
2022	Part of Dairy Product	Flow	280	1400	680	l/100 kg BR
	Processing (BR: BOD_5	BOD_5	0.35	9.3	0.60	kg/100 kg BR
	received)	SS	0.14	0.27	0.20	"
		NH_3-N	1	13	5.5	mg/l
	Avg. use is 8.67 kg	Tot N	1	120	64	mg/l
	milk per kg cheese	PO_4	9	210	48	"
	produced	Cl^-	46	1900	480(high)	"
	1 kg BOD_5 received = about 10 kg milk received	pH	4.0	11	7.8	standard
		BOD_5			900	mg/l
		SS			280	mg/l
2026	Part of Dairy Product	Flow	430	8500	3900	l/100 kg BR
	Processing (BR:BOD_5 received)	BOD_5	0.30	7.2	3.2	kg/100 kg BR
	Avg. use is .85 kg milk per kg milk produced	SS	1.4	3.4	1.5	"

(continued)

TABLE D-1 (continued)

SIC	Title, comments	Parameter	Low	High	Average value	Units
2026 (cont.)	Part of Dairy Product Processing	BOD_5			830	mg/l
		SS			390	"
2037	Part of Canned and Preserved Fruits and Vegetables Processing (apple juice)	Flow	1900	3500	2900	l/kkg
		BOD	1.6	2.6	2.1	kg/kkg
		SS	0.15	0.4	0.3	"
	(citrus products) (kkg of raw fruit processed)	Flow	710	25000	10,000	l/kkg
		BOD	0.45	8.5	3.2	kg/kkg
		SS	0.02	8.0	1.3	"
2077	Renderer segm. of Meat Products RM: raw materials avg. = 94 kkg/day	Flow	470	20000	3300	l/kkg RM
		BOD_5	.10	5.8	2.2	kg/kkg RM
		SS	.03	5.2	1.1	"
		Grease	0	4.2	.72	"
		COD	1.6	37	8.0	"
		TVS	.04	13	3.3	"
		TDS	.01	12	3.5	"
		TKN	.12	1.2	0.48	"
		NH_3	.08	.74	.30	"
		NO_3	.0001	.06	.008	"
		NO_2	.00002	.040	.003	"
		Cl	.08	2.6	.80	"
		Tot P	.003	.28	.044	"
2812	Part of Major Inorganic Products seg. of Inorganic Chemicals Manufacturing	Purification muds	0.5	35	16	kg/kkg Cl_2
		NaOH	0.5	32	14	"
		NaCl	15	500	210	"
	Data are for the mercury cell process	Chlorinated hydrocarbons	0	1.5	0.7	"
		H_2SO_4	0	50	16	"

(continued)

TABLE D-1 (continued)

SIC	Title, comments	Parameter	Low	High	Average value	Units
2812 (cont.)	Part of Major Inorganic Products	Na_2SO_4	0	63	16	kg/kkg Cl_2
		$CaOCl_2$	0	75	11	"
		Filter aids	0	5	.85	"
		Mercury	0.02	.28	.15	"
		Graphite	0.35	340	20	"
2951	Part of Paving and Roofing Materials	Flow			68000	l/day
		Total solids			14000	mg/l
		TSS			14000	mg/l
	Data for ashphalt concrete plants; asphalt emulsion plants have no discharge except oil polluted stormwater	Alkalinity			420	mg/l
		Production			540	kkg/day
2952	Part of Paving and Roofing Materials	Flow			570	kl/day
		Total solids			550	mg/l
		TDS			280	"
		TSS			180	"
		BOD_5			12	"
		Oil/grease			15	"
		Production			450	kkg/day
3211	Flat Glass seg. of Glass Manufacturing	Flow			46	kl/kkg
	Plate glass	SS			700	kg/kkg
	No process water for sheet glass or folled glass subcategories	COD			4.6	kg/kkg
		Dissolved solids			8.0	kg/kkg
	(Float glass)	Flow			140	l/kkg
		SS			2	g/kkg
		Oil			0.7	"

(continued)

TABLE D-1 (continued)

SIC	Title, comments	Parameter	Low	High	Average value	Units
3211	Flat Glass seg. of	COD			2	g/kkg
	Glass Manufacturing	BOD			.25	"
		Dissolved solids			14	"
3221	Pressed and Blown	Flow			2900	l/kkg
	Glass seg. of Glass	BOD			.01	kg/kkg
	Manufacturing	COD			.14	"
	(Glass containers)	SS			.07	"
		Oil			.03	"
3229	Pressed and Blown Glass	Flow			8300	l/kkg
	seg. of Glass Manufacturing	COD			.08	kg/kkg
	(Glass tubing)	SS			.22	kg/kkg
		Oil			.08	"
	(Hand pressed and blown	Flow			12000	l/kkg
	glass)	SS			7.5	kg/kkg
	Pressed and Blown Glass	Lead			.28	"
	seg. of Glass Manufacturing	Flouride			4.9	"
3231	Flat Glass seg. of	Flow			180	l/sq m
	Glass Manufacturing	SS			4.4	g/sq m
	(Automotive glass	Oil			300	"
	lamination)	COD			300	"
		BOD			5.9	"
		Tot P			.98	"
3241	Cement Manufacturing			Leaching	Non-Leaching	
		Alkalinity		1.4	.09	kg/kkg
		TSS		0.91	0	"
		Chloride		1.2	0	"
		Aluminum		.64	.009	"
		Iron		4.8	.16	"

(continued)

TABLE D-1 (continued)

SIC	Title, comments	Parameter	Low	High	Average value	Units
3241 (cont.)	Cement Manufacturing		Leaching		Non-Leaching	
		TDS	6.6		.27	kg/kkg
		Flow			5100	l/kkg
3292	Asbestos Manufacturing	Flow			10	kl/kkg
		SS			5	kg/kkg
		BOD$_5$			.020	kg/kkg
		Alkalinity			5	"
		pH			12	standard
3312	Iron and Steel Manufacturing	Flow	150	20000	420	l/kkg
		Ammonia	.73	1.1	.93	kg/kkg
		BOD$_5$	.17	1.8	.50	"
	By-product Coke	Cyanide	.014	.15	.070	"
		Phenol	.12	.26	.18	"
		O&G	.020	.13	.061	"
		SS	.019	.44	.18	"
		Sulfide	.030	.33	.15	"
	Burden Preparation - Sintering	Flow	430	1400	900	l/kkg
		Fluoride			1.1	g/kkg
		O/G	.22	.65	.44	kg/kkg
		Sulfide	.080	.092	.086	"
		SS	1.9	28	15	"
	Iron Blast Furnace	Flow	8100	22000	14000	l/kkg
		Ammonia	.031	.16	.090	kg/kkg
		Cyanide	0	.032	.0098	"
		Fluoride	0	.030	.010	"
		Phenol	0	.013	.0054	"
		Sulfide	0	.31	.10	"
		SS	4.3	39	16	"

(continued)

TABLE D-1 (continued)

SIC	Title, comments	Paramater	Low	High	Average value	Units
3312 (cont.)	Ferromanganese Blast Furnace	Flow			32000	1/kkg
		Ammonia			3.7	kg/kkg
		Cyanide			.76	"
		Manganese			28	"
		Phenol			.0042	"
		SS			160	"
	Basic Oxygen Furnace	Flow	540	4200	2300	1/kkg
		Fluoride	.0030	.028	.013	kg/kkg
		SS	.17	9.6	3.5	"
	Open Hearth Furnace	Flow	2300	2500	2400	1/kkg
		Fluoride	.040	.054	.050	kg/kkg
		Nitrate	.051	.080	.064	"
		SS	.98	8.9	5.0	"
		Zinc	.0052	2.0	1.0	"
	Electric Arc Furnace	Flow	1.1	1200	600	1/kkg
		Fluoride	0	.018	.012	kg/kkg
		SS	.35	32	9.0	"
	Vacuum Degassing	Flow	800	3800	2300	1/kkg
		Lead	.0011	.0018	.0014	kg/kkg
		Nitrate	.0024	.095	.049	"
		Manganese	.010	.022	.016	"
		SS	.058	.087	.072	"
		Zinc	.0063	.0076	.0069	"
	Continuous Casting	Flow	6200	17000	12000	1/kkg
		O/G	.14	.35	.24	kg/kkg
		SS	.14	.46	.30	"

(continued)

TABLE D-1 (continued)

SIC	Title, comments	Parameter	Low	High	Average value	Units
3312	Hot Forming and Cold	Flow	2100	3700	3100	1/kkg
3315	Finishing segment	SS	.028	.32	.14	kg/kkg
3316	of Iron and Steel	O/G	.0065	.32	.11	"
3317	Manufacturing	pH	7.6	8.0		standard
	Hot Forming - Primary					
	Hot Forming - Section	Flow	2500	58000	37000	1/kkg
		SS	.21	2.6	1.2	kg/kkg
		O/G	.021	.60	.17	"
		pH	6.7	8.3		standard
	Hot Forming - Flat	Flow	23000	35000	31000	1/kkg
		SS	.21	1.3	.64	kg/kkg
		O/G	.074	.30	.15	"
		pH	7.0	8.4		standard
	Pipe and Tubes	Flow	2100	53000	18000	1/kkg
		SS	.15	1.4	.68	kg/kkg
		O/G	0	1.5	.38	"
		pH	5.5	8.2	7	standard
	H_2SO_4 Pickling - Batch Concentrated	Flow	23	100	62	1/kkg
		Iron(diss)	1.6	2.9	2.04	kg/kkg
		SS	0	.00088	-	kg/kkg
		O/G	0	.0011	-	"
		pH	1.0	2.0		standard
	H_2SO_4 Pickling - Batch Rinse	Flow	33	1900	640	1/kkg
		Iron(diss)	.069	.49	.27	kg/kkg
		SS	.00066	.13	.054	"
		O/G	0	.046	.013	"
		pH	1.0	6.4	2	standard

(continued)

TABLE D-1 (continued)

SIC	Title, comments	Parameter	Low	High	Average value	Units
3312- 3317 (cont.)	H_2SO_4 Pickling - Continuous	Flow	61	90	76	1/kkg
		Iron(diss)	.16	2.1	1.1	kg/kkg
		SS	.0040	.0044	.0042	"
		O/G	.00045	.0011	.00078	"
		pH	1.0	1.6		standard
	HCl Pickling - Concentrated	Flow	14	170	58	1/kkg
		Iron	1.6	7.6	7.9	kg/kkg
		SS	.00054	.021	.0077	"
		O/G	0	.00018	.00006	"
		pH	All less than 1			standard
	HCl Pickling - Rinse	Flow	24	2700	850	1/kkg
		Iron(diss)	.0064	1.04	.28	kg/kkg
		SS	0	.049	.015	"
		O/G	0	.023	.0048	"
		pH	1.1	5.0	2-3	standard
	Cold Rolling subcat.	Flow	67	3700	1400	1/kkg
		SS	.0037	3.6	1.2	kg/kkg
		O/G	.044	5.2	2.6	"
		Iron(diss)	.0035	29	8.1	g/kkg
		pH	4.8	8.1	7	standard
	Hot Coatings - Galvanizing	Flow	920	18000	6700	1/kkg
		SS	.088	.50	.31	kg/kkg
		O/G	.0022	.098	.068	"
		Zinc	.000045	.74	.37	"
		Total Cr	.0093	.047	.028	"
		Hex Cr	.0065	.046	.026	g/kkg
		pH	1.2	11	3	standard

(continued)

TABLE D-1 (continued)

SIC	Title, comments	Parameter	Low	High	Average value	Units
3312- 3317 (cont.)	Hot Coatings - Terne Plate	Flow	2200	9200	5600	1/kkg
		SS	.073	.10	.088	kg/kkg
		Lead	.00043	.00045	.00044	"
		O/G	.022	.027	.024	"
		Tin	.0043	.018	.014	"
		pH	2.2	5.2		standard
3341	Secondary Copper subcat. of the Copper seg. of Nonferrous Metals Manufacturing	Flow	24	230	130	kl/kkg
		SS	3.3	10	6.8	kg/kkg
		Copper	.092	.65	.37	"
		Zinc	.13	.56	.34	"
		O/G	.42	.42	.42	"
		pH			7	standard
		Lead	.035	.042	.22	kg/kkg
		Iron	1.02	1.02	1.02	"
		Fluoride, Aluminum, Antimony, Arsenic, Boron, Cadmium, Chromium, Cobalt, Manganese, Mercury, Nickel, Selenium, Silver, Tin, and Phenols				

KEY TO PARAMETERS APPEARING IN APPENDIX D

SS - suspended solids

BOD_5 - biochemical oxygen demand measured at 5 days

E. Coli - _Escherichia coli_ or coliform bacteria

O&G - oil and grease

NH_3-N - ammonia nitrogen

Total P - total phosphorous

COD - chemical oxygen demand

TOC - total organic carbon

S - sulfide

Cr^{+6} (Hex Cr) - hexavalent chromium

Cr-TOT - total chromium

Zn - zinc

E. Coli (fecal) - _Escherichia coli_ of fecal origin

TKN (Kjel N) - total Kjeldahl nitrogen

Cl - chloride

Tot N - total nitrogen

PO_4 - phosphate

TVS - total volatile solids

TDS - total dissolved solids

NO_3 - nitrate nitrogen

NO_2 - nitrite nitrogen

NaOH - sodium hydroxide

NaCl - sodium chloride

H_2SO_4 - sulfuric acid

Na_2SO_4 - sodium sulfate

$Ca(OCl)_2$ - calcium hypochlorite

TSS - total suspended solids

Iron (diss) - dissolved iron

BR - BOD_5 received

APPENDIX E

RESIDUE GENERATED BY INDIVIDUAL ALLEGHENY COUNTY INDUSTRIES

TABLE E-1. ALLEGHENY CO. INDUSTRIAL RESIDUES
SORT 1 INDIVIDUAL INDUSTRY RESIDUE GENERATION

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THE FOLLOWING INFORMATION IS  PRESENTED.

COLUMN          DESCRIPTION

ID              INDIVIDUAL INDUSTRY CONSULTANT I.D. NUMBER

NAME            INDIVIDUAL INDUSTRY NAME

MUN             MUNICIPALITY LOCATION CODE

001 ALEPPO TWP.            002 ASPINWALL BORO.          003 AVALON BORO.
004 BALDWIN BORO.          005 BALDWIN TWP.             006 BELL ACRES BORO.
007 BELLEVUE BORO.         008 BEN AVON BORO.           009 BEN AVON HEIGHTS BORO.
010 BETHEL PARK BORO.      001 BLAWNOX BORO.            012 BRACKENRIDGE BORO.
013 BRADDOCK BORO.         014 BRADDOCK HILLS BORO.     015 BRADFORD WOODS BORO.
016 BRENTWOOD BORO.        017 BRIDGEVILLE BORO.        018 CARNEGIE BORO.
019 CASTLE SHANNON         020 CHALFONT BORO.           021 CHESWICK BORO.
022 CHURCHILL BORO.        023 CLAIRTON CITY            024 COLLIER TWP.
025 CORAOPOLIS BORO.       026 CRAFTON BORO.            027 CRESCENT TWP.
028 DORMONT BORO.          029 DRAVOSBURG BORO.         030 DUQUESNE CITY
031 EAST DEER TWP.         032 EAST MCKEESPORT BORO.    033 EAST PITTSBURGH BORO.
034 EDGEWOOD BORO.         035 EDGEWORTH BORO.          036 ELIZABETH BORO.
037 ELIZABETH TWP.         038 EMSWORTH BORO.           039 ETNA BORO.
040 FAWN TWP.              041 FINDLAY TWP.             042 FOREST HILLS BORO.
043 FORWARD TWP            044 FOX CHAPEL BORO.         045 FRANKLIN PARK TWP.
046 FRAZER TWP.            047 GLASSPORT BORO.          048 GLEN FIELD BORO.
049 GREENTREE BORO.        050 HAMPTON TWP.             051 HARMAR TWP.
052 HARRISON TWP.          053 HAYSVILLE BORO.          054 HEIDELBERG BORO.
055 HOMESTEAD BORO.        056 INDIANA TWP.             057 INGRAM BORO.
058 JEFFERSON BORO.        059 KENNEDY TWP.             060 KILBUCK TWP.
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(continued)

TABLE E-1 (continued)

061	LEET TWP.	062	LEETSDALE BORO.	063	LIBERTY BORO.
064	LINCOLN BORO.	065	MCCANDLESS TWP.	066	MCDONALD BORO.(PART)
067	MCKEESPORT CITY	068	MCKEES ROCKS BORO.	069	MARSHALL TWP.
070	MILLVALE BORO.	071	MONROEVILLE BORO.	072	MOON TWP.
073	MOUNT LEBANON TWP.	074	MOUNT OLIVER BORO.	075	MUNHALL BORO.
076	NEVILLE TWP.	077	NORTH BRADDOCK BORO.	078	NORTH FAYETTE TWP.
079	NORTH VERSAILLES	080	OAKDALE BORO.	081	OAKMONT BORO.
082	OHARA TWP.	083	OHIO TWP.	084	OSBORNE BORO.
085	PENN HILLS TWP.	086	PINE TWP.	087	PITCAIRN BORO.
088	PITTSBURGH CITY	089	PLEASANT HILLS BORO.	090	PLUM BORO.
091	PORT VUE BORO.	092	RANKIN BORO.	093	RESERVE TWP.
094	RICHLAND TWP.	095	ROBINSON TWP.	096	ROSS TWP.
097	ROSSLYN FARMS BORO.	098	SCOTT TWP.	099	SEWICKLEY BORO.
100	SEWICKLEY HEIGHTS BORO.	101	SEWICKLEY HILLS BORO.	102	SHALER TWP.
103	SHARPSBURG BORO.	104	SOUTH FAYETTE TWP.	105	SOUTH PARK TWP.
106	SOUTH VERSAILLES TWP.	107	SPRING DALE BORO.	108	SPRINGDALE TWP.
109	STOWE TWP.	110	SWISSVALE BORO.	111	TARENTUM BORO.
112	THORNBURG BORO.	113	TRAFFORD BORO.(PART)	114	TURTLE CREEK BORO.
115	UPPER ST. CLAIR TWP.	116	VERONA BORO.	117	VERSAILLES BORO.
118	WALL BORO.	119	WEST DEER TWP.	120	WEST ELIZABETH BORO.
121	WEST HOMESTEAD BORO.	122	WEST MIFFLIN BORO.	123	WEST VIEW BORO.
124	WHITAKER BORO.	125	WHITEHALL BORO.	126	WHITE OAK BORO.
127	WILKINS TWP.	128	WILKINSBURGHBORO.	129	WILMERDING BORO.

(continued)

TABLE E-1 (continued)

COLUMN	DESCRIPTION
ZIP	ZIP CODE
SIC	STANDARD INDUSTRIAL CLASSIFICATION
DP	DISCHARGE POINT CODE. 1 DIRECT STREAM 2 MUNCIPAL SEWER 3 BOTH DIRECT STREAM AND MUN. SEWER
EMPL	EMPLOYMENT
PRODUCTION AMT.	AVERAGE DAILY PRODUCTION (EXPONENTIAL)
CODE	TYPE OF PRODUCTION AND UNITS CODE 01 KKG PRODUCT 02 KKG PRODUCT(ESTIMATED) 03 CANS PRODUCT 04 KLITERSPRODUCT 05 KLITERS PRODUCT(ESTIMATED) 06 KKG RAWMATERIAL 07 BARRELS 08 KKG COKE 09 KKG SINTER 10 KKG IRON 11 KKG FERROMANGANESE 12 KKG STEEL (BOF) 13 KKG STEEL (OPEN HEARTH) 14 KKG STEEL (ELECTRIC) 15 KKG PRIMARY HOT ROLLED STEEL 16 KKG CONTINUOUS CAST STEEL

(continued)

TABLE E-1 (continued)

17	KKG VACUUM DEGASSED STEEL
18	KKG SECONDARY HOT ROLLED STEEL
19	KKG PIPES AND TUBES
20	KKG COLD ROLLED STEEL
21	KKG WIRE
22	KKG PICKLED STEEL
23	KKG HOT COATED STEEL
24	SHIPS
25	AIRCRAFT SERVICED
26	KKG STEAM
27	MEGAWATT CAPACITY
28	CARS WASHED
29	UNITS
30	SQUARE METERS
31	KKG CERAMIC COLORS
32	KKG ALUM POWDER
33	HEATING ELEMENTS
34	KKG RESINS
35	KKG DETINNED STEEL
36	KKG TIN CHEMICALS
37	KKG PHTHALIC,MALEIC ANHYDRIDES
38	KKG WATER TREATMENT CHEMICALS
39	KKG OXYGEN,NITROGEN
40	KKG ACTIVATED CARBON
41	KG ORGANO-METALIC CHEMICALS
42	KKG INDUSTRIAL SOLVENTS
43	KKG PESTICIDES
44.	MGD WASTEWATER TREATED
45	MGD WATER TREATED
46	MGD WATER TREATED AND SOFTENED

(continued)

TABLE E-1 (continued)

COLUMN	DESCRIPTION
RESIDUE-77,83 TYPE	RESIDUE CLASSIFICATION CODE
	A OILY WASTES
	A1 WASTEWATER TREATMENT SLUDGES
	A2 MACHINERY LUBRICANTS
	A3 HYDRAULIC OIL
	A4 EMULSIONS
	A5 ANIMAL FATS AND OILS
	A6 CUTTING OIL
	A7 TANK BOTTOMS
	A9 OTHER
	B WASTE SOLVENTS
	B1 PAINT MANUFACTURE
	B2 RESIN MANUFACTURE
	B3 METAL CLEANING
	B4 PRINTING
	B9 OTHER
	C ORGANIC RESIDUES
	C1 FOOD PROCESSING
	C2 PHARMACEUTICALS
	C3 COAL FINES
	C4 MUNICIPAL WASTEWATER TREATMENT SLUDGES
	C5 CLEANING EMULSIONS
	C9 OTHER

(continued)

TABLE E-1 (continued)

D		HEAVY METAL - CONTAINING RESIDUES
	D1	HYDROXIDE SLUDGES
	D2	METAL FINISHING
	D3	SPENT PICKLE LIQUOR(H2SO4)
	D4	SPENT PICKLE LIQUOR(HCL)
	D5	AIR POLLUTION CONTROL DUSTS
	D6	SCRUBBER SLUDGE
	D7	SCALE
	D8	FOUNDRY SAND AND METALLICS
	D9	OTHER
E		INORGANIC RESIDUES
	E1	WASTE FOUNDRY SAND
	E2	IRON SLAG
	E3	STEEL SLAG
	E4	FGD SLUDGES
	E5	CULLET-GLASS MANUFACTURE
	E6	CEMENT DUST
	E7	WATER TREATMENT SLUDGES
	E8	FLYASH
	E9	OTHER
F		TOXIC CHEMICAL WASTES
	F1	ACIDS
	F2	CAUSTICS
	F3	ORGANICS
	F4	PAINTS,DYES
	F5	INORGANICS
	F6	COKE WASTEWATER TREATMENT SLUDGE
	F7	PITCH SAND,TAR
	F9	OTHER

AMT.   AVERAGE DAILY RESIDUE PRODUCTION IN KG/DAY
XA,XB,ETC. INDICATES RESIDUES ARE CONTAINERIZED-AMT. IN 55 GAL. DRUMS

(continued)

TABLE E-1 (continued)

ID	MUN	ZIP	SIC	DP	EMPL	PRODUCTION AMT.	PRODUCTION CODE	RESIDUE-77 TYPE	RESIDUE-77 AMT.	RESIDUE-83 TYPE	RESIDUE-83 AMT.
1	85	15139	1211	1	0			D1	4.2E+02	D1	4.2E+02
2	51	15024	1211	1	0	3.6E+3	01		0.0E+00		0.0E+00
3	78	0	1211	1	90	5.4E+2	02	C3	3.9E+04	C3	3.9E+04
4	90	15239	1211	1	0	3.6E+3	01	C3	2.6E+05	C3	2.6E+05
5	119	0	1211	1	267	1.6E+3	02	C3 D1	4.7E+05 1.0E+04	C3 D1	4.7E+05 1.0E+04
7	88	15205	2011	2	436	2.4E+2	06	A5	9.4E+02	A5	9.4E+02
8	88	15212	2011	2	141	7.9E+1	06	A5	3.1E+02	A5	3.1E+02
9	90	15239	2011	1	8	4.5E+0	06	A5	2.5E+02	A5	2.5E+02
10	116	15147	2022	2	7	1.4E+0	06	C1	1.3E+04	C1	1.3E+04
11	88	15212	2032	2	1796	1.1E+7	03	E8	5.2E+03	E8	5.2E+03
12	88	15212	2051	2	748	9.7E+1	01		0.0E+00		0.0E+00
13	88	15222	2077	2	60	1.3E+2	06	A5	5.2E+01	A5	5.2E+01
14	88	15201	2082	0	537	4.9E+2	04		0.0E+00		0.0E+00
15	52	15065	2086	1	10	5.9E+0	05	C1	6.7E+01	C1	7.0E+01
16	24	15106	2098	1	102			C1	3.0E+01	C1	3.0E+01
17	78	0	2077	1	2	2.3E+0	06		0.0E+00	C1	4.5E+00

(continued)

TABLE E-1 (continued)

18	18	15106	2258	2	41	7.4E+0	02	0.0E+00	0.0E+00
19	10	15102	2269	2	28	5.0E+0	02	0.0E+00	0.0E+00
20	119	0	2391	1	84				
22	88	15238	2641	2	614			0.0E+00	0.0E+00
23	81	15139	2643	1	143			C5 1.6E+01	C5 1.6E+01
24	88	15222	2653	1	396	1.8E+2	01	XC9 6.6E-02 C9 3.7E+01	XC9 6.6E-02 C9 3.7E+01
25	31	15030	2813	1	17	4.8E+2	39	A2 4.8E+00	A2 4.8E+00
26	88	15201	2813	1	11	3.1E+2	39	A2 3.1E+00	A2 3.1E+00

(continued)

TABLE E-1 (continued)

ID	MUN	ZIP	SIC	DP	EMPL	PRODUCTION		RESIDUE-77		RESIDUE-83	
						AMT.	CODE	TYPE	AMT.	TYPE	AMT.
27	88	15230	2711	2	1769			XB4 A2	8.2E-01 1.6E+02	XB4 A2	8.2E-01 1.6E+02
28	90	15239	2751	1	90	4.0E+2	02		0.0E+00		0.0E+00
29	82	15238	2752	2	203				0.0E+00		0.0E+00
30	88	15233	2752	2	239				0.0E+00		0.0E+00
33	122	15122	2813	2	30				0.0E+00		0.0E+00
34	88	15233	2813	1	0			XF9 XE9	1.5E-02 4.4E-02	XF9 XE9	1.5E-02 4.4E-02
35	88	15204	2816	2	55	3.0E+0	01	XF4	1.2E+01	XF4	1.2E+01
36	58	15025	2819	1	32						
37	88	15212	2819	2	8		38		0.0E+00		0.0E+00
38	76	15225	2819	2	90		40		0.0E+00		0.0E+00
39	88	15201	2819	2	15		41	XF3	2.2E-01	XF3	2.2E-01
40	95	0	2819	1	0	3.2E-1	01				
41	88	15201	2821	2	5						
42	23	0	2821	0	549		34	F5	9.0E+02	F5	9.0E+02
43	108	15144	2851	2	141	6.3E+0	05	XB1	3.3E+00	XB1	3.3E+00
44	76	15225	2851	2	22	3.8E+0	05	XB1	2.0E+00	XB1	2.0E+00

(continued)

TABLE E-1 (continued)

45	103	15215	2869	2	21		42		0.0E+00		0.0E+00
46	76	15225	2869	3	477	5.5E+2	37	F3 E7	1.5E+04 1.3E+03	F3 E7	1.5E+04 1.3E+03
48	17	15017	2821	0	278	2.5E+2	37	XB2	3.3E+00	XB2	3.3E+00
49	76	15225	2821	3	300	1.5E+2	34	F3	7.6E+03	F3	7.6E+03
50	67	15135	2821	2	1						
51	116	15147	2834	2	196				0.0E+00		0.0E+00
52	78	0	2834	1	36						
53	81	15139	2834	2	25						

(continued)

TABLE E-1 (continued)

ID	MUN	ZIP	SIC	DP	EMPL	PRODUCTION		RESIDUE-77		RESIDUE-83	
						AMT.	CODE	TYPE	AMT.	TYPE	AMT.
54	25	15108	2844	2	57						
55	104	15321	2851	1	21	3.6E+0	05	B1 F4	3.0E+02 2.0E+01	B1 F4	3.0E+02 2.0E+01
56	102	15116	2851	2	36	6.2E+0	05	B1 F4	5.1E+02 3.4E+01	B1 F4	5.1E+02 3.4E+01
57	88	15201	2851	2	20	3.4E+0	05	B1 F4	2.9E+02 1.9E+01	B1 F4	2.9E+02 1.9E+01
58	68	15136	2851	2	2	3.4E-1	05	B1 F4	2.9E+01 1.9E+00	B1 F4	2.9E+01 1.9E+00
59	88	15233	2851	2	195	1.8E+1	04	B1 F4	1.3E+03 1.8E+02	B1 F4	1.3E+03 1.8E+02
60	107	15144	2851	1	656	5.2E+1	04	XF4 F2 F5 B1	6.4E+00 2.2E+03 1.9E+03 4.3E+03	XF4 F2 F5 B1	6.4E+00 2.2E+03 1.9E+03 4.3E+03
61	13	15104	2851	2	3	5.1E-1	05	B1 F4	4.2E+01 2.8E+00	B1 F4	4.2E+01 2.8E+00
62	12	15014	2851	2	10	1.7E+0	05	B1 F4	1.4E+02 9.4E+00	B1 F4	1.4E+02 9.4E+00
63	88	15204	2851	2	22	3.8E+0	05	B1 F4	3.2E+02 2.1E+01	B1 F4	3.2E+02 2.1E+01
64	88	15233	2851	2	5	8.6E-1	05	B1 F4	7.1E+01 4.7E+00	B1 F4	7.1E+01 4.7E+00

(continued)

TABLE E-1 (continued)

65	11	15238	2851	2	49	1.5E+0 1.0E+2	04 31	B1 2.1E+02 F4 1.4E+01	B1 2.1E+02 F4 1.4E+01
66	81	15139	2851	2	42	3.8E+0	04	XB1 1.0E+00 XF4 1.0E-01	XB1 1.0E+00 XF4 1.0E-01
67	88	15201	2891	2	24			F2 1.8E+02	F2 1.8E+02
68	53	15143	2891	2	84			F2 6.3E+02	F2 6.3E+02
69	98	15106	2891	2	4			F2 3.0E+01	F2 3.0E+01
70	88	15201	2893	2	9			F4 6.2E-01	F4 6.2E-01
71	103	15215	2893	2	23	9.0E-1	01	F4 1.6E+00	F4 1.6E+00

(continued)

TABLE E-1 (continued)

ID	MUN	ZIP	SIC	DP	EMPL	PRODUCTION		RESIDUE-77		RESIDUE-83	
						AMT.	CODE	TYPE	AMT.	TYPE	AMT.
72	88	15224	2899	2	1						
73	18	15106	2899	2	49		38		0.0E+00		0.0E+00
75	18	15106	2899	3	65	1.9E+1	31	B1	1.4E+02	B1	1.4E+02
76	68	15136	2899	2	106				0.0E+00		0.0E+00
77	67	15134	2899	2	4				0.0E+00		0.0E+00
78	88	15212	2899	2	4				0.0E+00		0.0E+00
79	29	15034	2951	2	10	5.4E+2	02		0.0E+00		0.0E+00
80	68	15136	2951	1	10	5.4E+2	02		0.0E+00		0.0E+00
81	81	15139	2951	1	0				0.0E+00		0.0E+00
82	88	15201	2952	1	100	8.7E+1	05		0.0E+00		0.0E+00
83	88	15201	2992	3	98	2.3E+2	04	A1	3.8E+02	A1	3.8E+02
84	24	15106	2992	1	6	1.4E+1	05	A1	2.5E+01	A1	2.5E+01
85	76	15225	2992	1	12	1.2E+1	01	A1	4.4E-01	A1	4.4E-01
86	31	15030	2992	2	38	8.7E+1	05		0.0E+00		0.0E+00
87	94	15007	2992	1	69	1.6E+2	05	A1	2.6E+00	A1	2.6E+00
88	122	0	2951	2	5	2.7E+2	01		0.0E+00		0.0E+00
89	63	0	2999	2	30				0.0E+00		0.0E+00

(continued)

TABLE E-1 (continued)

90	21	15024	3079	2	97	2.3E+0	02	0.0E+00	0.0E+00
91	72	15108	3079	1	84	2.0E+0	01	C5 1.5E+02 A1 6.7E+01	C5 1.5E+02 A1 6.7E+01
92	95	15244	3079	2	67	1.6E+0	02	0.0E+00	0.0E+00
93	68	15136	3079	2	626	6.2E+1	01	0.0E+00	0.0E+00
94	10	15102	3079	2	72	1.7E+0	02	0.0E+00	0.0E+00
95	32	15035	3079	2	136	3.3E+0	02	0.0E+00	0.0E+00
96	116	15147	3079	2	67	1.6E+0	02	0.0E+00	0.0E+00
97	78	15071	3079	2	92	2.2E+0	02	0.0E+00	0.0E+00

(continued)

TABLE E-1 (continued)

ID	MUN	ZIP	SIC	DP	EMPL	PRODUCTION		RESIDUE-77		RESIDUE-83	
						AMT.	CODE	TYPE	AMT.	TYPE	AMT.
98	116	15147	3079	1	110	2.6E+0	02	C5 A1	2.0E+02 8.8E+01	C5 A1	2.0E+02 8.8E+01
99	58	0	3211	1	152	8.4E+1	02		0.0E+00		0.0E+00
100	102	15116	3221	1	400	3.9E+2	01	E5 A1	2.5E+02 6.5E+01	E5 A1	2.5E+02 6.5E+01
101	17	15017	3229	3	172	3.6E+1	01			E5	3.7E+01
102	110	15218	3229	2	176	2.7E+0	02	E5	4.0E+02	E5	4.0E+02
103	12	0	3231	2	264	1.9E+1	02		0.0E+00		0.0E+00
104	31	15030	3231	1	920	4.0E+2	01	E5	3.6E+03	E5	5.0E+03
105	117	0	3231	2	70	5.0E+0	02		0.0E+00		0.0E+00
106	76	15225	3241	1	94	1.2E+3	01	E6	3.6E+04	E6	3.6E+04
107	85	15235	3241	2	174	9.7E+2	02	E6	6.7E+04	E6	6.7E+04
108	51	10000	3251	0	58						
109	31	15030	3255	1	51	4.3E+1	01	E6	1.1E+01	E6	1.1E+01
110	88	15208	3272	2	11	4.1E+1	01	E6	1.5E+01	E6	1.5E+01
111	88	15219	3272	1	46	1.7E+2	02	E6	6.4E+03	E6	6.4E+03
112	21	15024	3273	1	13	2.4E+2	02			E6	2.4E+02
113	98	15106	3281	1	4			E1	1.5E+02	E1	1.5E+02

(continued)

TABLE E-1 (continued)

114	70	15209	3281	1	8			E1 5.0E+02	E1 5.0E+02
115	88	15222	3291	1	27	2.4E+1	02		
116	107	15144	3291	1	47	4.1E+1	01		
117	51	0	3291	2	14	4.3E+0	02	E1 4.0E+02	E1 4.0E+02
118	122	15122	3295	1	79	3.7E+3	01	0.0E+00	0.0E+00
119	75	15120	3312	1	9617	3.1E+3 6.4E+3 1.3E+4 1.2E+4 7.9E+3	10 13 09 15 18	A6 1.3E+04 E2 6.2E+05 E3 6.4E+05	A6 1.7E+04 E2 6.2E+05 E3 6.4E+05

(continued)

TABLE E-1 (continued)

ID	MUN	ZIP	SIC	DP	EMPL	PRODUCTION		RESIDUE-77		RESIDUE-83	
						AMT.	CODE	TYPE	AMT.	TYPE	AMT.
120	122	0	3312	0	0	0.0E+0	00	D6	4.5E+05	D6	4.6E+05
								E8	1.8E+04	E8	1.8E+04
121	67	15134	3312	1	4118	4.6E+3	10	A6	2.3E+03	A6	2.3E+03
						1.8E+3	15	E2	5.5E+05	E2	5.5E+05
						1.5E+3	18	D3	1.1E+05	D3	1.1E+05
						4.9E+3	19	D1	0.0E+00	D1	2.7E+05
						3.5E+3	22	D7	0.0E+00	D7	2.4E+04
122	23	15025	3312	1	3886	2.0E+4	08	F6	3.3E+04	F6	3.4E+04
						5.9E+2	11	A7	2.4E+03	A7	3.5E+03
						2.2E+3	18	F7	1.9E+04	F7	1.9E+04
								E8	3.8E+04	E8	3.8E+04
								D7	0.0E+00	D7	2.6E+04
123	30	15110	3312	1	3236	5.4E+3	10	A6	2.2E+03	A6	2.3E+03
						6.8E+3	12	E2	1.2E+06	E2	1.2E+06
						1.5E+3	14	E3	6.8E+05	E3	6.8E+05
						1.5E+3	17	D7	0.0E+00	D7	2.2E+04
						4.1E+3	15				
						6.8E+2	18				
124	77	15104	3312	1	2677	7.8E+3	10	A6	2.2E+03	A6	2.3E+03
						5.9E+3	12	E2	7.2E+05	E2	7.2E+05
						2.0E+3	09	E3	5.9E+05	E3	5.9E+05
						6.2E+3	15	D7	0.0E+00	D7	2.1E+04
125	122	15122	3312	1	3992	6.4E+3	18	A6	2.0E+04	A6	2.1E+04
						8.5E+3	20	D1	1.1E+06	D1	1.6E+06
						8.0E+3	22	D2	4.2E+04	D2	4.2E+04
						1.2E+3	23	D7	0.0E+00	D7	9.1E+04

(continued)

TABLE E-1 (continued)

126	24	15028	3312	1	1076	2.4E+2	14	D6 3.0E+04	D6 3.0E+04
						1.6E+2	16	A1 8.4E+01	A1 8.4E+01
						1.4E+2	21	D2 1.8E+04	D2 1.8E+04
								E3 2.4E+04	E3 2.4E+04
								D3 1.2E+03	D3 1.2E+03
127	52	15024	3312	1	3947	3.0E+3	10	D2 6.5E+03	D2 6.5E+03
						1.7E+3	12	D6 6.5E+03	D6 6.5E+03
						9.1E+2	14	D7 6.5E+03	D7 6.5E+03
						4.2E+3	15	D3 9.1E+04	D3 9.1E+04
						4.2E+3	20	E3 1.3E+05	E3 1.3E+05
						3.0E+3	22		
128	76	15225	3312	1	639	1.8E+3	08	F3 1.8E+02	F3 1.8E+02
						1.2E+3	10	F6 5.9E+03	F6 5.9E+03
								D6 1.5E+04	D6 1.5E+04
								D5 1.9E+04	D5 1.9E+04
								E2 3.1E+05	E2 3.1E+05

(continued)

TABLE E-1 (continued)

ID	MUN	ZIP	SIC	DP	EMPL	PRODUCTION		RESIDUE-77		RESIDUE-83	
						AMT.	CODE	TYPE	AMT.	TYPE	AMT.
129	81	15139	3312	1	1027	1.5E+2	14	D6	1.2E+03	D6	1.2E+03
						1.5E+2	15	D7	5.1E+02	D7	5.1E+02
								A6	5.6E+01	A6	5.6E+01
								E3	1.5E+04	E3	1.5E+04
130	88	0	3312	1	330	2.5E+1	16	D7	1.3E+03	D7	1.[illegible]E+03
						1.2E+1	20	A6	3.6E+01	A6	5.8E+01
						1.2E+1	19	D3	1.1E+03	D3	1.1E+03
131	88	15213	3312	1	6378	5.1E+3	08	F6	0.0E+00	F6	4.6E+04
						2.3E+3	10	D6	4.5E+03	D6	0.0E+00
						4.3E+3	13	D5	4.2E+04	D5	2.5E+04
						7.0E+0	14	A6	4.1E+03	A6	4.9E+03
						4.2E+3	15	D3	1.0E+05	D3	1.0E+05
						3.3E+3	18				
						3.0E+2	20				
						3.5E+3	22				
						3.7E+2	23				
131	88	15213	3312	0	0			D2	6.9E+03	D2	7.4E+03
								E2	8.8E+05	E2	0.0E+00
								E3	1.2E+06	E3	1.6E+05
								F7	1.5E+03	F7	1.5E+03
131	88	15213	3312	0	0			D1	0.0E+00	D1	2.7E+05
								D7	0.0E+00	D7	5.4E+04
								E8	9.1E+03	E8	9.1E+03
132	67	15134	3315	2	17	1.3E+1	02	D2	1.6E+03	D2	1.6E+03
								F1	6.2E+00	F1	6.2E+00
133	97	15106	3316	3	450	7.5E+1	18	A4	8.1E+01	A4	8.1E+01
						7.5E+1	20	D3	2.3E+03	D3	2.3E+03
						7.5E+1	22			D7	3.2E+04

(continued)

TABLE E-1 (continued)

134	109	15136	3317	2	43	6.5E+0	02	D7 5.1E+00	D7 5.1E+00
135	88	15201	3321	3	268	3.7E+1	01	D8 2.1E+02 E1 1.6E+03 E2 7.4E+03	D8 2.1E+02 E1 1.6E+03 E2 7.4E+03
136	88	15203	3321	2	450	3.0E+1	01	D8 1.7E+02 E1 2.1E+03 E2 6.0E+03	D8 1.7E+02 E1 2.1E+03 E2 6.0E+03
137	31	0	3321	2	47	2.5E+1	02	D8 1.5E+02 E1 1.8E+03 E2 5.0E+03	D8 1.5E+02 E1 1.8E+03 E2 5.0E+03
138	76	15225	3321	3	424	6.4E+2	01	D8 3.6E+03 E1 4.5E+04	D8 3.6E+03 E1 4.5E+04

(continued)

TABLE E-1 (continued)

ID	MUN	ZIP	SIC	DP	EMPL	PRODUCTION		RESIDUE-77		RESIDUE-83	
						AMT.	CODE	TYPE	AMT.	TYPE	AMT.
139	88	15201	3321	2	30	1.6E+1	02	D8 E1 E2	9.1E+01 1.1E+03 3.2E+03	D8 F1 E2	9.1E+01 1.1E+03 3.2E+03
140	88	15201	3325	2	500	9.0E+1	02	D8 E1	1.7E+03 8.5E+03	D8 E1	2.2E+03 8.5E+03
141	47	15045	3325	1	700	4.5E+1	01	D8 E1	8.6E+02 2.3E+03	D8 E1	1.1E+02 2.3E+03
142	128	15221	3325	2	47	8.5E+0	02	D8 E1	1.6E+02 8.0E+02	D8 E1	2.0E+02 8.0E+02
143	67	15134	3325	0	450	8.1E+1	02	D8 E1 F1	1.5E+03 1.7E+04 4.0E+00	D8 E1 F1	1.9E+03 1.7E+04 4.0E+00
144	88	15201	3325	3	387	4.5E+1	01	D8 E1	3.6E+03 4.2E+03	D8 E1	4.5E+03 4.2E+03
145	116	15147	3325	3	301	1.8E+1	01	D8 E1	4.5E+02 1.7E+03	D8 E1	5.7E+02 1.7E+03
146	120	0	3339	1	38	4.9E+1	02				
147	64	15037	3341	1	79	1.4E+2	02	D6	1.1E+04	D6	1.1E+04
148	88	15220	3341	2	30	5.4E+1	02				
149	88	15224	3341	2	13	2.3E+1	02				
150	88	15207	3341	2	3	5.4E+0	02				

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TABLE E-1 (continued)

151	76	15225	3341	1	138	2.0E+2 7.4E+0	35 36	F2	6.3E+03	F2	6.3E+03
152	62	15056	3351	1	370	2.1E+1	01	D2 D3	1.3E+04 2.1E+03	D2 D3	1.3E+04 2.1E+03
153	47	15045	3351	1	550	9.8E+1	21		0.0E+00		0.0E+00
154	71	15146	3356	2	12	2.3E+0	02				
155	88	15201	3361	2	9	1.2E-1	01	D6	1.4E+00	D6	1.4E+00
156	110	15218	3361	2	27	8.6E-1	02	D6	4.1E+00	D6	4.1E+00
157	110	15218	3361	2	37	1.2E+0	02	D6	5.6E+00	D6	5.6E+00
158	88	15201	3362	2	14	2.5E-1	02	D8 E1	1.0E+02 2.0E+02	D8 E1	1.0E+02 2.0E+02

(continued)

TABLE E-1 (continued)

ID	MUN	ZIP	SIC	DP	EMPL	PRODUCTION AMT.	PRODUCTION CODE	RESIDUE-77 TYPE	RESIDUE-77 AMT.	RESIDUE-83 TYPE	RESIDUE-83 AMT.
159	102	15116	3362	2	23	3.4E-1	01	D8 E1	2.8E+01 5.6E+01	D8 E1	2.8E+01 5.6E+01
160	88	15233	3362	2	16	2.9E-1	02	D8 E1	2.4E+01 4.8E+01	D8 E1	2.4E+01 4.8E+01
161	88	15222	3362	2	18	1.5E+0	01	D8 E1	1.2E+02 2.4E+02	D8 E1	1.2E+02 2.4E+02
162	88	15220	3362	2	39	7.0E-1	02	D8 E1	5.8E+01 1.2E+02	D8 E1	5.8E+01 1.2E+02
163	88	15226	3362	2	180	2.7E+0	01	D8 E1	2.3E+02 5.6E+02	D8 E1	2.3E+02 5.6E+02
164	88	15201	3362	2	12	1.0E+0	01	D8 E1	8.3E+01 1.7E+02	D8 E1	8.3E+01 1.7E+02
165	111	15084	3362	2	23	4.1E-0	02	D8 E1	3.4E+01 6.8E+01	D8 E1	3.4E+01 6.8E+01
166	88	15201	3362	2	17	7.3E-1	01	D8 E1	6.1E+01 1.2E+02	D8 E1	6.1E+01 1.2E+02
167	127	0	3362	3	152	4.6E+1	01	D8 E1	3.8E+03 7.6E+03	D8 E1	3.8E+03 7.6E+03
168	88	15224	3362	0	9	1.3E+0	01	D8 E1	1.1E+02 2.2E+02	D8 E1	1.1E+02 2.2E+02
169	90	15239	3339	2	80	2.2E+1	31	D9	8.8E+02	D9	8.8E+02
170	37	15135	3399	1	101	1.3E+2	02	D9	4.4E+02	D9	4.4E+02

(continued)

TABLE E-1 (continued)

171	46	15084	3399	1	9	1.2E+1	02	D9	4.0E+01	D9	4.0E+01
172	37	15018	3399	1	53	1.0E+1	02	D9	2.3E+02	D9	2.3E+02
173	122	15122	3399	2	71	1.3E+1	02	D9	0.0E+00	D9	0.0E+00
174	122	15122	3411	2	500	3.2E+5	29	XB4	2.0E+00	XB4	2.0E+00
175	94	15007	3412	1	28	1.3E+2	07	B4	2.3E+00	B4	2.3E+00
176	62	15056	3412	2	140	6.6E+2	07	B4	1.2E+00	B4	1.2E+00
177	88	15201	3412	2	0						
178	81	15139	3423	2	130	9.0E+0	01	D5	1.5E+01	D5	1.5E+01

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TYPING GUIDE SHEET
BEGIN FIRST LINE OF TEXT HERE
DROPPED HEAD-BEGIN SECTIONS HERE
CENTER OF PAGE
TOP OF IMAGE AREA

TABLE E-1 (continued)

ID	MUN	ZIP	SIC	DP	EMPL	PRODUCTION AMT.	PRODUCTION CODE	RESIDUE-77 TYPE	RESIDUE-77 AMT.	RESIDUE-83 TYPE	RESIDUE-83 AMT.
179	92	0	3432	1	223	5.6E+0	02				
180	21	15024	3433	2	34	1.7E+0	02				
181	62	0	3441	1	100	1.2E+2	01	D7 A1	1.3E+02 2.6E+01	D7 A1	1.3E+02 2.6E+01
182	116	15147	3441	2	234	3.5E+1	02		0.0E+00		0.0E+00
183	88	15203	3441	2	492	1.1E+2	02		0.0E+00		0.0E+00
184	104	15017	3441	2	64	9.6E+0	02		0.0E+00		0.0E+00
185	67	15134	3441	2	188	2.8E+1	02		0.0E+00		0.0E+00
186	88	15201	3441	2	397	6.0E+1	02		0.0E+00		0.0E+00
187	67	15134	3443	1	489	1.5E+2	01	D6 A1	3.3E+02 2.5E+02	D6 A1	3.3E+02 2.5E+02
188	43	0	3443	1	600	6.9E+1	01	D8	9.3E+01	D8	9.3E+01
189	76	15225	3443	3	619	2.0E+1	01		0.0E+00		0.0E+00
190	117	0	3443	2	101	9.5E+0	02		0.0E+00		0.0E+00
191	124	0	3443	2	60	5.6E+0	02		0.0E+00		0.0E+00
192	54	15106	3444	1	168	3.1E+2	01	B3	6.3E+01	B3	6.3E+01
193	11	15238	3446	1	600	5.0E+1	02		0.0E+00		0.0E+00
194	6	15143	3452	1	21	1.5E+0	02	D3 A6	1.7E+02 6.6E+00	D3 A6	1.7E+02 6.6E+00

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TABLE E-1 (continued)

195	72	15108	3452	1	300	3.0E+1	01	D3 4.3E+03 A6 1.6E+02	D3 4.3E+03 A6 1.6E+02
196	78	15070	3452	1	48	3.5E+0	02	D3 4.1E+02 A6 1.5E+01	D3 4.1E+02 A6 1.5E+01
197	68	15136	3462	1	429	1.5E+2	02	D7 6.0E+02 A1 3.7E+01	D7 6.0E+02 A1 3.7E+01
198	88	15233	3462	2	106	3.8E+1	02		
199	68	15136	3462	1	120	1.7E+1	02	D7 1.7E+02 A1 1.0E+01	D7 1.7E+02 A1 1.0E+01
200	88	15201	3462	1	779	2.9E+2	01	A1 6.7E+01	A1 6.7E+01

(continued)

TABLE E-1 (continued)

ID	MUN	ZIP	SIC	DP	EMPL	PRODUCTION AMT.	PRODUCTION CODE	RESIDUE-77 TYPE	RESIDUE-77 AMT.	RESIDUE-83 TYPE	RESIDUE-83 AMT.
201	25	15108	3462	1	937	2.8E+2	01		0.0E+00		0.0E+00
202	13	15104	3462	1	11	1.5E+0	02	D7 A1	5.4E+00 3.3E-01	D7 A1	5.4E+00 3.3E-01
203	13	15104	3462	1	125	1.8E+1	02	D7 A1	3.4E+02 2.0E+01	D7 A1	3.4E+02 2.0E+01
204	122	15122	3465	1	1490	3.9E+2	02	A1	6.3E+02	A1	6.3E+02
205	88	15208	3471	2	7	2.1E+0	02	D2	1.2E+02	D2	1.2E+02
206	110	15218	3471	2	15	4.5E+0	02	D2	1.5E-01	D2	1.5E-01
207	88	15233	3471	2	11	3.3E+0	02		0.0E+00	D1	1.9E+02
208	102	15116	3471	2	36	1.1E+1	02	D3	5.2E+02	D3	5.2E+02
209	67	15132	3471	2	202	9.6E+4	30	D2	2.3E+02	D2	2.3E+02
210	88	15213	3471	2	11	3.3E+0	02	D3 F2 F3	7.3E+00 7.3E+00 7.3E+00	D3 F2 F3	7.3E+00 7.3E+00 7.3E+00
211	88	15201	3471	2	11	3.3E+0	01	D2	1.9E+02	D2	1.9E+02
212	41	15126	3471	2	3	9.0E-1	02	D2	5.3E+01	D2	5.3E+01
213	88	15208	3471	2	12	3.6E+0	02	D2	2.1E+02	D2	2.1E+02
214	90	15239	3471	2	2	6.0E-1	02	D2	3.5E+01	D2	3.5E+01
215	123	15229	3471	2	3	9.0E-1	02	D2	5.3E+01	D2	5.3E+01

(continued)

TABLE E-1 (continued)

216	88	15203	3471	2	3	9.0E-1	02	D2 5.3E+01 D3 2.1E+01	D2 5.3E+01 D3 2.1E+01
217	88	15206	3471	2	2	6.0E-1	02	D2 3.5E+01	D2 3.5E+01
218	88	15228	3471	2	2	6.0E-1	02	D2 3.5E+01	D2 3.5E+01
219	111	15084	3479	2	50	2.3E+1	02	0.0E+00	0.0E+00
220	80	15071	3479	1	16	7.4E+0	02	D3 1.0E+01	D3 1.0E+01
221	80	15071	3479	2	10	4.6E+0	02	0.0E+00	0.0E+00
222	95	15205	3479	2	1	4.6E-1	02	0.0E+00	0.0E+00
223	88	15201	3479	2	65	8.0E+1	01	D3 6.3E+00	D3 6.3E+00

(continued)

TABLE E-1 (continued)

ID	MUN	ZIP	SIC	DP	EMPL	PRODUCTION		RESIDUE-77		RESIDUE-83	
						AMT.	CODE	TYPE	AMT.	TYPE	AMT.
224	18	15106	3479	2	5	2.3E+0	02		0.0E+00		0.0E+00
225	92	0	3479	2	86	4.0E+1	02	XD5	1.6E-02	XD5	1.6E-02
226	18	15106	3479	2	18	8.3E+0	02		0.0E+00		0.0E+00
227	76	15225	3479	2	65	3.0E+1	02		0.0E+00		0.0E+00
228	88	15222	3479	2	4	1.8E+0	02		0.0E+00		0.0E+00
229	26	15205	3479	2	93	4.3E+1	02	B1	2.6E+02	B1	2.6E+02
230	27	0	3479	2	30	1.4 +1	02		0.0E+00		0.0E+00
231	80	15071	3479	2	24	1.1E+1	02		0.0E+00		0.0E+00
232	10	15102	3479	2	14	6.4E+0	02		0.0E+00		0.0E+00
233	38	0	3479	2	146	6.7 +1	01	B3	3.9E+01	B3	3.9E+01
234	24	15017	3484	2	45	3.0E-1	02				
235	88	15201	3493	3	146	7.8E+1	01	D7 A1	3.3E+01 7.3E+00	D7 A1	3.3E+01 7.3E+00
236	25	15108	3493	2	123	2.3E+1	02		0.0E+00		0.0E+00
237	43	15063	3493	1	348	2.8E+1	01		0.0E+00		0.0E+00
238	88	15233	3494	2	410	9.0E+1	02				
239	50	15101	3494	1	192	2.9E+1	01	D7 A1	4.3E+01 9.4E+00	D7 A1	4.3E+01 9.4E+00

(continued)

TABLE E-1 (continued)

240	25	15108	3494	2	309	6.8E+0	02		
241	88	15230	3494	1	289	6.4E+0	02	D7 6.4E+01 A1 1.4E+01	D7 6.4E+01 A1 1.4E+01
242	41	15147	3494	2	32	7.0E-1	02		
243	69	15086	3498	1	20	1.4E+0	02	D7 4.5E+00 A1 1.0E+00	D7 4.5E+00 A1 1.0E+00
244	104	15017	3499	2	105	5.3E+0	02		
245	33	15112	3511	1	7133			D2 2.2E+03 B3 5.1E+02	D2 2.2E+03 B3 5.1E+02
246	117	15132	3544	2	77	6.9E-1	02		

(continued)

TABLE E-1 (continued)

ID	MUN	ZIP	SIC	DP	EMPL	PRODUCTION AMT.	PRODUCTION CODE	RESIDUE-77 TYPE	RESIDUE-77 AMT.	RESIDUE-83 TYPE	RESIDUE-83 AMT.
247	37	0	3544	1	14	1.2E-1	02	D7 A1	2.7E-01 1.1E-01	D7 A1	2.7E-01 1.1E-01
248	37	15135	3544	1	58	5.2E-1	02	D7 A1	1.1E+00 4.6E-01	D7 A1	1.1E+00 4.6E-01
249	121	0	3545	2	203	3.9E-1	02				
250	67	15134	3545	1	358	6.8E-1	02	D7 A1	6.8E+00 3.0E+00	D7 A1	6.8E+00 3.0E+00
251	18	15106	3545	3	285	5.4E-1 6.8E+1	02 14	D7 A1 D5 E3	5.4E+00 2.3E+00 5.7E+02 6.8E+03	D7 A1 D5 E3	5.4E+00 2.3E+00 5.7E+02 6.8E+03
252	121	0	3547	3	2220	2.2E+2	01	A4	3.8E+03	A4	3.8E+03
253	88	15233	3555	2	493						
254	21	15024	3561	1	1104	8.2E+1	30		0.0E+00		0.0E+00
255	72	15108	3563	1	373			D7	6.5E+01	D7	6.5E+01
256	81	15139	3563	1	252			D7 A1	7.1E+00 1.5E+00	D7 A1	7.1E+00 1.5E+00
257	76	15225	3566	1	103	3.9E+0	01	D7 A1	2.9E+00 6.2E-01	D7 A1	2.9E+00 6.2E-01
258	88	15208	3567	2	1380	1.5E+5	33	XA4	5.5E-02	XA4	5.5E-02
259	88	15201	3567	2	272	2.4E+0	02	A4	2.2E+00	A4	2.2E+00

(continued)

TABLE E-1 (continued)

260	11	15238	3573	2	747			0.0E+00	0.0E+00
261	10	15102	3599	2	84	9.2E-1	02		
262	86	15090	3599	1	15	1.7E-1	02		
263	33	15112	3613	2	2474	4.0E+1	02	0.0E+00	0.0E+00
264	113	0	3613	2	1240	4.1E+1	01	0.0E+00	0.0E+00
265	79	0	3621	1	96	3.8E+0	02		
266	88	15206	3621	1	72	2.9E+0	02	0.0E+00	0.0E+00
267	90	15239	3622	2	148	1.1E+0	02		

(continued)

TYPING GUIDE SHEET

TABLE E-1 (continued)

ID	MUN	ZIP	SIC	DP	EMPL	PRODUCTION AMT.	PRODUCTION CODE	RESIDUE-77 TYPE	RESIDUE-77 AMT.	RESIDUE-83 TYPE	RESIDUE-83 AMT.
268	122	15122	3629	2	250						
269	110	15218	3662	2	1361	2.2E+0	02				
270	37	15135	3679	1	32						
271	41	15231	3679	1	40						
272	10	15102	3694	0	51	5.4E+0	01				
273	76	15225	3731	1	1954	7.5E-1	24		0.0E+00		0.0E+00
274	107	15144	3743	2	56	4.8E+0	02				
275	129	15148	3743	1	3338	1.6E+2	01	A4 D8 F5	1.6E+02 1.9E+03 1.2E+03	A4 D8 F5	1.6E+02 1.9E+03 1.2E+03
276	11	15238	3829	2	362	4.7E-1	02	XB3	2.9E-01	XB3	2.9E-01
277	88	15208	3842	2	1609				0.0E+00		0.0E+00
278	88	15206	3953	2	225						
279	62	15056	3955	2	175			XB3	1.2E+00	XB3	1.2E+00
280	71	15146	4011	1	0						
281	88	0	4011	1	500			C5 A1	7.8E+02 1.9E+02	C5 A1	7.8E+02 1.9E+02
282	88	15211	4011	1	108	1.0E+0	28	C5 A1	1.3E+03 6.5E+01	C5 A1	1.4E+03 6.7E+01

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TABLE E-1 (continued)

283	71	15146	4011	1	159	2.4E+0	28	C5 1.8E+02 A1 8.6E+00	C5 1.8E+02 A1 8.9E+00
284	68	15136	4011	1	170	4.8E+0	28	A1 2.0E+01	A1 2.0E+01
285	88	15222	4011	1	600			C5 9.4E+02 A1 2.3E+02	C5 9.4E+02 A1 2.3E+02
286	4	15227	4011	1	12	3.0E-1	28	C5 2.2E+01 A1 1.1E+00	C5 2.3E+01 A1 1.1E+00
287	49	15205	4011	1	50	3.0E+0	28	C5 2.2E+02	C5 2.2E+02
288	76	15225	4231	1	0				
289	72	0	4582	1	290				

(continued)

TABLE E-1 (continued)

ID	MUN	ZIP	SIC	DP	EMPL	PRODUCTION AMT.	PRODUCTION CODE	RESIDUE-77 TYPE	RESIDUE-77 AMT.	RESIDUE-83 TYPE	RESIDUE-83 AMT.
290	11	15238	4463	1	50						
291	72	0	4583	1	0	6.0E+0	25			C5	2.6E+03
292	88	15204	4911	1	0	3.5E+2	27		0.0E+00		0.0E+00
293	107	15024	4911	1	0	5.6E+2	27	E8	5.7E+05	E8 E4	5.7E+05 5.8E+05
294	27	0	4911	1	0	3.8E+2	27	E8 E4	5.0E+05 5.1E+05	E8 E4	5.0E+05 5.1E+05
295	108	15144	4911	1	0	2.2E+2	27		0.0E+00		0.0E+00
296	88	0	4961	1	34	1.7E+3	26		0.0E+00		0.0E+00
297	48	15025	4911	1	0	4.8E+2	27	E8	6.0E+05	E8 E4	6.0E+05 6.1E+05
298	88	15213	4961	1	0		26	E8	1.2E+04	E8	1.2E+04
299	25	15108	5171	1	0						
300	25	15108	5171	1	50						
301	58	0	5171	1	20						
302	76	15225	5171	1	75						
303	88	0	5171	1	0						
304	68	15136	5171	1	100						

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TABLE E-1 (continued)

305	29	0	5171	1	0				
306	85	15222	5171	1	0				
307	94	0	7215	1	0				
308	94	15044	7215	1	0				
309	22	0	7391	1	2300	A6	1.1E+03	A6	1.1E+03
310	42	15221	7391	1	0				
311	58	0	7391	1	550				
312	85	15146	7391	1	100		0.0E+00		0.0E+00
313	122	15122	7391	1	62				

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TABLE E-1 (continued)

ID	MUN	ZIP	SIC	DP	EMPL	PRODUCTION AMT.	PRODUCTION CODE	RESIDUE-77 TYPE	RESIDUE-77 AMT.	RESIDUE-83 TYPE	RESIDUE-83 AMT.
314	51	0	7391	1	1532			A1	4.7E+00	A1	4.7E+00
315	51	15238	7391	1	0						
316	85	15146	7391	1	0						
317	88	15227	7391	1	7438						
318	95	0	7391	1	87						
319	105	0	7391	1	0						
320	82	0	7538	1	50						
321	7	15202	7542	1	4						
322	16	15227	7542	1	20						
323	62	15056	7542	1	9						
324	65	15090	7542	1	2						
331	71	15146	2011	2	0			C1	3.1E+03	C1	3.1E+03
332	88	15206	2051	2	648	6.5E+1	01	A5 C1	2.7E+01 3.9E+02	A5 C1	2.7E+01 3.9E+02
333	88	15222	3545	0	38			A1 D7	2.5E+00 3.1E-01	A1 D7	2.5E+00 3.1E-01
334	102	15116	3545	0	94			D1	5.2E+02	D1	5.2E+02
335	10	0	4952	0	0	4.8E+0	44	C4	1.8E+04	C4	3.0E+04

(continued)

TABLE E-1 (continued)

336	23	0	4952	0	0	1.2E+0	44	C4	3.0E+03	C4	5.1E+03
337	25	0	4952	0	0	2.7E+0	44	C4	7.2E+03	C4	1.2E+04
338	27	0	4952	0	0	2.0E-1	44	C4	4.5E+02	C4	7.7E+02
339	29	0	4952	0	0	3.1E-1	44	C4	6.0E+02	C4	6.0E+02
340	30	0	4952	0	0	1.5E+0	44	C4	6.1E+03	C4	6.1E+03
341	31	0	4952	0	0	4.0E+0	44	C4	9.1E+03	C4	1.5E+04
342	36	0	4952	0	0	5.0E-1	44	C4	1.5E+03	C4	1.5E+03
343	37	0	4952	0	0	5.0E-1	44	C4	6.1E+03	C4	6.1E+03

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TABLE E-1 (continued)

ID	MUN	ZIP	SIC	DP	EMPL	PRODUCTION		RESIDUE-77		RESIDUE-83	
						AMT.	CODE	TYPE	AMT.	TYPE	AMT.
344	47	0	4952	0	0	1.1E+0	44	C4	2.1E+03	C4	2.1E+03
345	50	0	4952	0	0	5.0E-1	44	C4	5.5E+02	C4	5.5E+02
346	51	0	4952	0	0	3.0E+0	44	C4	3.9E+03	C4	3.9E+03
347	62	0	4952	0	0	6.3E+1	44	C4	0.0E+00	C4	2.4E+03
348	69	0	4952	0	0	1.1E+0	44	C4	4.5E+03	C4	4.5E+03
349	69	0	4952	0	0	1.2E-1	44	C4	4.7E+03	C4	4.7E+03
350	69	0	4952	0	0	3.0E+0	44	C4	9.5E+03	C4	9.5E+03
351	69	0	4952	0	0	1.2E-1	44	C4	4.7E+02	C4	4.7E+02
352	68	0	4952	0	0	5.5E+0	44	C4	1.3E+04	C4	2.2E+04
353	72	0	4952	0	0	1.8E-1	44	C4	3.3E+02	C4	3.3E+02
354	72	0	4952	0	0	1.7E+0	44	C4	7.0E+03	C4	7.0E+03
355	81	0	4952	0	0	2.8E-1	44	C4	6.2E+02	C4	1.0E+03
356	82	0	4952	0	0	1.5E+0	44	C4	2.0E+03	C4	2.0E+03
357	85	0	4952	0	0	8.5E-1	44	C4	3.3E+03	C4	3.3E+03
358	85	0	4952	0	0	2.1E+0	44	C4	8.2E+03	C4	8.2E+03
359	85	0	4952	0	0	1.3E+0	44	C4	5.0E+03	C4	5.0E+03
360	85	0	4952	0	0	1.3E-1	44	C4	2.5E+02	C4	2.5E+02

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TABLE E-1 (continued)

361	85	0	4952	0	0	8.5E-1	44	C4	1.3E+04	C4	1.3E+04
362	88	15233	4952	0	0	1.8E+2	44	C4	4.8E+05	C4	4.8E+05
363	89	0	4952	0	0	2.4E+0	44	C4	4.6E+03	C4	4.6E+03
364	90	0	4952	0	0	1.4E-1	44	C4	5.2E+02	C4	5.2E+02
365	89	0	4952	0	0	8.0E-1	44	C4	3.8E+03	C4	3.8E+03
366	94	0	4952	0	0	2.1E-1	44	C4	4.5E+03	C4	4.5E+03
367	95	0	4952	0	0	3.0E-1	44	C4	9.0E+02	C4	9.0E+02
368	95	0	4952	0	0	2.5E-1	44	C4	4.8E+02	C4	4.8E+02

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TYPING GUIDE SHEET

TABLE E-1 (continued)

ID	MUN	ZIP	SIC	DP	EMPL	PRODUCTION AMT.	PRODUCTION CODE	RESIDUE-77 TYPE	RESIDUE-77 AMT.	RESIDUE-83 TYPE	RESIDUE-83 AMT.
369	99	0	4952	0	0	7.0E-1	44	C4	1.2E+04	C4	1.2E+04
370	106	0	4952	0	0	5.0E-1	44	C4	6.1E+02	C4	6.1E+02
371	119	0	4952	0	0	1.0E-1	44	C4	1.9E+02	C4	1.9E+02
372	122	0	4952	0	0	1.7E+0	44	C4	3.3E+03	C4	3.3E+03
373	122	0	4952	0	0	8.0E-1	44	C4	1.5E+03	C4	1.5E+03
374	41	0	4952	0	0	2.6E-1	44	C4	4.8E+02	C4	4.8E+02
375	17	0	4952	0	0	6.0E-1	44	C4	0.0E+00	C4	2.3E+03
376	118	0	4952	0	0	1.5E-1	44	C4	0.0E+00	C4	5.8E+02
371	47	0	4952	0	0	4.0E-1	44	C4	0.0E+00	C4	1.5E+03
372	11	0	4941	0	0	2.8E-1	46	E7	1.1E+04	E7	1.1E+04
373	12	0	4941	0	0	1.0E+0	46	E7	2.0E+04	E7	2.0E+04
374	13	0	4941	0	0	2.0E+0	45	E7	2.3E+04	E7	2.3E+04
375	21	0	4941	0	0	1.8E-1	46	E7	4.1E+03	E7	4.1E+03
376	25	0	4941	0	0	1.0E+0	46	E7	6.2E+04	E7	6.2E+04
377	30	0	4941	0	0	1.4E+0	45	E7	1.5E+04	E7	1.5E+04
388	35	0	4941	0	0	8.0E-1	46	E7	1.4E+04	E7	1.4E+04
389	37	0	4941	0	0	1.0E+0	45	E7	2.0E+03	E7	2.0E+03

(continued)

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TABLE E-1 (continued)

390	44	0	4941	0	0	1.8E+0	46	E7	2.9E+04	E7	3.1E+04
391	60	0	4941	0	0	2.5E-1	46	E7	1.1E+04	E7	1.1E+04
392	52	0	4941	0	0	1.5E-1	45	E7	1.5E+04	E7	1.8E+04
393	65	0	4941	0	0	9.0E+0	45	E7	1.0E+05	E7	1.0E+05
394	71	0	4941	0	0	3.3E+0	46	E7	5.8E+04	E7	5.8E+04
395	70	0	4941	0	0	8.0E-1	46	E7	8.3E+03	E7	8.3E+03
396	72	0	4941	0	0	1.8E+0	46	E7	4.6E+04	E7	4.6E+04
397	79	0	4941	0	0	5.0E-1	45	E7	3.8E+03	E7	5.9E+03

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TABLE E-1 (continued)

ID	MUN	ZIP	SIC	DP	EMPL	PRODUCTION AMT.	PRODUCTION CODE	RESIDUE-77 TYPE	RESIDUE-77 AMT.	RESIDUE-83 TYPE	RESIDUE-83 AMT.
398	82	0	4941	0	0	5.3E+0	45	E7	6.0E+04	E7	6.0E+04
399	128	0	4941	0	0	2.3E+1	45	E7	1.8E+04	E7	4.7E+04
400	88	0	4941	0	0	6.0E+1	45	E7	5.7E+05	E7	5.7E+05
401	88	0	4941	0	0	9.3E+1	45	E7	1.9E+05	E7	1.9E+05
402	95	0	4941	0	0	1.5E+0	45	E7	1.6E+04	E7	1.6E+04
403	99	0	4941	0	0	9.0E-1	46	E7	3.2E+04	E7	3.2E+04
404	108	0	4941	0	0	4.9E-1	46	E7	5.2E+03	E7	5.2E+03
405	111	0	4941	0	0	1.2E-1	46	E7	3.0E+04	E7	3.0E+04
406	76	0	4941	0	0	1.5E+1	46	E7	2.0E+05	E7	2.0E+05
407	102	0	4941	0	0	2.4E+0	46	E7	4.9E+04	E7	4.9E+04
408	69	0	4941	0	0	3.0E-1	45	E7	3.8E+03	E7	3.8E+03

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APPENDIX F

RESIDUE TOTALS BY COLLECTION DISTRICT WITHIN ALLEGHENY COUNTY

(See Appendix E for Printout Legend)

TABLE F-1. ALLEGHENY COUNTY COLLECTION DISTRICT MUNICIPALITIES

District 1 - South Central

88	Pittsburgh (Wards 16, 17, 18, 19, 20, 28, 29, 30, 32)				
17	Bridgeville	57	Ingram	24	Collier
18	Carnegie	74	Mt. Oliver	98	Scott
26	Crafton	97	Rosslyn Farms		
49	Greentree	112	Thornburg		
54	Heidelberg				

District 2 - East Central

88	Pittsburgh (Wards 4, 7, 12, 13, 14, 15, 31)				
13	Braddock	55	Homestead	121	W. Homestead
14	Braddock Hills	75	Munhall	124	Whitaker
22	Churchill	77	N. Braddock	128	Wilkensburg
34	Edgewood	92	Rankin		
42	Forest Hills	110	Swissvale		

District 3 - North Central

88	Pittsburgh (Wards 1, 2, 3, 5, 6, 8, 9, 10, 11, 21,22,23,24,25,26,27)				
2	Aspinwall	70	Millvale	93	Reserve
39	Etna	103	Sharpsburg	102	Shaler

District 4 - West Central

3	Avalon	48	Glenfield	76	Neville
7	Bellvue	68	McKees Rocks	95	Robinson
8	Ben Avon	123	West View	96	Ross
9	Ben Avon Heights	1	Aleppo	109	Stowe
25	Coraopolis	59	Kennedy		
38	Emsworth	60	Kilbuck		

District 5 - Northwest

5	Bell Acres	101	Sewickley Hills	83	Ohio
15	Bradford Woods	50	Hampton	86	Pine
45	Franklin Park	69	Marshall	94	Richland
100	Sewickley Heights	65	McCandless		

(continued)

TABLE F-1 (continued)

District 6 - Northeast

11	Blawnox	111	Tarentum	52	Harrison
12	Brackenridge	31	E. Deer	56	Indiana
21	Cheswick	40	Fawn	82	O'Hara
44	Fox Chapel	46	Frazer	108	Springdale Twp.
107	Springdale Boro	51	Harmar	119	W. Deer

District 7 - East

30	Duquesne	87	Pittcairn	79	N. Versailles
20	Chalfont	90	Plum	85	Penn Hills
32	E. McKeesport	114	Turtle Creek	127	Wilkins
33	E. Pittsburgh	116	Verona		
71	Monroeville	118	Wall		
81	Oakmont	129	Wilmerding		

District 8 - Southeast

23	Clairton	63	Liberty	120	W. Elizabeth
67	McKeesport	64	Lincoln	126	White Oak
36	Elizabeth Boro	91	Port Vue	37	Elizabeth Twp.
47	Glassport	117	Versailles	43	Forward
				106	S. Versailles

District 9 - South

4	Baldwin Boro	29	Dravosburg	5	Baldwin Twp.
10	Bethel Park	58	Jefferson	73	Mt. Lebanon
16	Brentwood	89	Pleasant Hills	115	Up. St. Clair
19	Castle Shannon	122	W. Mifflin	105	South Park
28	Dormont	125	Whitehall		

District 10 - West

35	Edgeworth	84	Osborne	61	Leet
53	Haysville	99	Sewickley	72	Moon
62	Leetsdale	27	Crescent	78	N. Fayette
80	Oakdale	41	Findlay	104	S. Fayette

TABLE F-2. ALLEGHENY COUNTY INDUSTRIAL RESIDUES
SORT 2 - DAILY RESIDUE TOTALS BY COLLECTION DISTRICT

COLLECTION DISTRICT NUMBER 1 - SOUTH CENTRAL

RESIDUE TYPE		1977-NO. OF INDUSTRIES	RESIDUES	1983-NO. OF INDUSTRIES	RESIDUES
A. OILY WASTES	-KGS	5	0.257E 03	5	0.259E 03
A1 WWT SLUDGES	-KGS	4	0.176E 03	4	0.178E 03
A4 EMULSIONS	-KGS	1	0.810E 02	1	0.810E 02
B. WASTE SOLVENTS	-KGS	4	0.783E 03	4	0.783E 03
B. WASTE SOLVENTS	-DRUMS	1	0.330E 01	1	0.330E 01
B1 PAINT MANUF.	-KGS	3	0.720E 03	3	0.720E 03
B2 RESIN MANUF.	-DRUMS	1	0.330E 01	1	0.330E 01
B3 METAL CLEANING	-KGS	1	0.630E 02	1	0.630E 02
C. ORGANIC RESIDUES	-KGS	4	0.155E 04	4	0.395E 04
C1 FOOD PROCESSING	-KGS	1	0.300E 02	1	0.300E 02
C4 MUNICIPAL WWT	-KGS	1	0.000E 00	1	0.230E 04
C5 CLEANING EMULSIONS	-KGS	2	0.152E 04	2	0.162E 04
D. HEAVY METAL CONTAINING	-KGS	11	0.526E 05	12	0.846E 05
D2 METAL FINISHING	-KGS	2	0.180E 05	2	0.180E 05
D3 SPENT PIC LIQ-H2SO4	-KGS	3	0.352E 04	3	0.352E 04
D5 AIR POL CONT DUSTS	-KGS	1	0.570E 03	1	0.570E 03
D6 SCRUBBER SLUDGES	-KGS	1	0.300E 05	1	0.300E 05
D7 SCALE	-KGS	1	0.540E 01	2	0.320E 05
D8 FOUNDRY SAND+METALLICS	-KGS	3	0.458E 03	3	0.458E 03
E. INORGANIC RESIDUES	-KGS	7	0.397E 05	8	0.397E 05
E1 FOUNDRY SAND	-KGS	4	0.293E 04	4	0.293E 04
E2 IRON SLAG	-KGS	1	0.600E 04	1	0.600E 04
E3 STEEL SLAG	-KGS	2	0.308E 05	2	0.308E 05
E5 CULLET, GLASS MANUF.	-KGS	0	0.000E 00	1	0.370E 02
F. TOXIC CHEMICAL WASTES	-KGS	2	0.510E 02	2	0.510E 02
F. TOXIC CHEMICAL WASTES	-DRUMS	1	0.120E 02	1	0.120E 02
F2 CAUSTICS	-KGS	1	0.300E 02	1	0.300E 02
F4 WASTE PAINT & DYE	-KGS	1	0.210E 02	1	0.210E 02
F4 WASTE PAINT & DYE	-DRUMS	1	0.120E 02	1	0.120E 02

(continued)

TABLE F-2 (continued)

COLLECTION DISTRICT NUMBER RESIDUE TYPE		2 - EAST CENTRAL 1977-NO. OF INDUSTRIES	RESIDUES	1983-NO. OF INDUSTRIES	RESIDUES
A. OILY WASTES	-KGS	13	0.255E 05	13	0.305E 05
A. OILY WASTES	-DRUMS	1	0.550E-01	1	0.550E-01
A1 WWT SLUDGES	-KGS	4	0.224E 03	4	0.224E 03
A2 MACHINERY LUBRICANTS	-KGS	1	0.160E 03	1	0.160E 03
A4 EMULSIONS	-KGS	1	0.380E 04	1	0.380E 04
A4 EMULSIONS	-DRUMS	1	0.550E-01	1	0.550E-01
A5 ANIMAL OILS & FATS	-KGS	2	0.967E 03	2	0.967E 03
A6 CUTTING OIL	-KGS	5	0.204E 05	5	0.253E 05
B. WASTE SOLVENTS	-KGS	1	0.420E 02	1	0.420E 02
B. WASTE SOLVENTS	-DRUMS	1	0.820E 00	1	0.820E 00
B1 PAINT MANUF.	-KGS	1	0.420E 02	1	0.420E 02
B4 PRINTING, LITHO.	-DRUMS	1	0.820E 00	1	0.820E 00
C. ORGANIC RESIDUES	-KGS	2	0.117E 04	2	0.117E 04
C1 FOOD PROCESSING	-KGS	1	0.390E 03	1	0.390E 03
C5 CLEANING EMULSIONS	-KGS	1	0.780E 03	1	0.780E 03
D. HEAVY METAL CONTAINING	-KGS	21	0.156E 06	21	0.480E 06
D. HEAVY METAL CONTAINING	-DRUMS	1	0.160E-01	1	0.160E-01
D1 IRON HYDROXIDES	-KGS	1	0.000E 00	1	0.270E 06
D2 METAL FINISHING	-KGS	6	0.730E 04	6	0.780E 04
D3 SPENT PIC LIQ-H2SO4	-KGS	3	0.101E 06	3	0.101E 06
D5 AIR POL CONT DUSTS	-KGS	1	0.420E 05	1	0.250E 05
D5 AIR POL CONT DUSTS	-DRUMS	1	0.160E-01	1	0.160E-01
D6 SCRUBBER SLUDGES	-KGS	3	0.450E 04	3	0.970E 01
D7 SCALE	-KGS	6	0.170E 04	6	0.767E 05
D8 FOUNDRY SAND+METALLICS	-KGS	1	0.160E 03	1	0.200E 03
E. INORGANIC RESIDUES	-KGS	15	0.547E 07	15	0.358E 07
E1 FOUNDRY SAND	-KGS	1	0.800E 03	1	0.800E 03
E2 IRON SLAG	-KGS	3	0.222E 07	3	0.134E 07
E3 STEEL SLAG	-KGS	3	0.243E 07	3	0.139E 07
E5 CULLET, GLASS MANUF.	-KGS	1	0.400E 03	1	0.400E 03
E6 CEMENT DUSTS	-KGS	1	0.150E 02	1	0.150E 02
E7 WATER TRT. SLUDGES	-KGS	4	0.801E 06	4	0.830E 06
E8 FLY ASH	-KGS	2	0.211E 05	2	0.211E 05

(continued)

TABLE F-2 (continued)

F. TOXIC CHEMICAL WASTES	-KGS	5	0.151E 04	5	0.475E 05
F2 CAUSTICS	-KGS	1	0.730E 01	1	0.730E 01
F3 ORGANICS	-KGS	1	0.730E 01	1	0.730E 01
F4 WASTE PAINT & DYE	-KGS	1	0.280E 01	1	0.280E 01
F6 COKE PROD. SLUDGES	-KGS	1	0.000E 00	1	0.460E 05
F7 PITCH SAND, TAR	-KGS	1	0.150E 04	1	0.150E 04

(continued)

TABLE F-2 (continued)

COLLECTION DISTRICT NUMBER 3 - NORTH CENTRAL

RESIDUE TYPE		1977-NO. OF INDUSTRIES	RESIDUES	1983-NO. OF INDUSTRIES	RESIDUES
A. OILY WASTES	-KGS	10	0.111E 04	10	0.111E 04
A1 WWT SLUDGES	-KGS	6	0.751E 03	6	0.751E 03
A2 MACHINERY LUBRICANTS	-KGS	1	0.310E 01	1	0.310E 01
A4 EMULSIONS	-KGS	1	0.220E 01	1	0.220E 01
A5 ANIMAL OILS & FATS	-KGS	2	0.362E 03	2	0.362E 03
B. WASTE SOLVENTS	-KGS	4	0.217E 04	4	0.217E 04
B1 PAINT MANUF.	-KGS	4	0.217E 04	4	0.217E 04
C. ORGANIC RESIDUES	-KGS	3	0.480E 06	3	0.480E 06
C. ORGANIC RESIDUES	-DRUMS	1	0.660E-01	1	0.660E-01
C4 MUNICIPAL WWT	-KGS	1	0.480E 06	1	0.480E 06
C5 CLEANING EMULSIONS	-KGS	1	0.940E 03	1	0.940E 03
C9 OTHER	-KGS	1	0.370E 02	1	0.370E 02
C9 OTHER	-DRUMS	1	0.660E-01	1	0.660E-01
D. HEAVY METAL CONTAINING	-KGS	18	0.739E 04	19	0.898E 04
D1 IRON HYDROXIDES	-KGS	1	0.520E 03	2	0.710E 03
D2 METAL FINISHING	-KGS	1	0.190E 03	1	0.190E 03
D3 SPENT PIC LIQ-H2SO4	-KGS	2	0.526E 03	2	0.526E 03
D6 SCRUBBER SLUDGES	-KGS	1	0.140E 01	1	0.140E 01
D7 SCALE	-KGS	2	0.333E 02	2	0.333E 02
D8 FOUNDRY SAND+METALLICS	-KGS	11	0.612E 04	11	0.752E 04
E. INORGANIC RESIDUES	-KGS	19	0.967E 05	19	0.967E 05
E. INORGANIC RESIDUES	-DRUMS	1	0.440E-01	1	0.440E-01
E1 FOUNDRY SAND	-KGS	12	0.169E 05	12	0.169E 05
E2 IRON SLAG	-KGS	2	0.106E 05	2	0.106E 05
E5 CULLET, GLASS MANUF.	-KGS	1	0.250E 03	1	0.250E 03
E6 CEMENT DUSTS	-KGS	1	0.640E 04	1	0.640E 04
E7 WATER TRT. SLUDGES	-KGS	2	0.573E 05	2	0.573E 05
E8 FLY ASH	-KGS	1	0.520E 04	1	0.520E 04
E9 OTHER	-DRUMS	1	0.440E-01	1	0.440E-01

(continued)

TABLE F-2 (continued)

F. TOXIC CHEMICAL WASTES	-KGS	7	0.419E 03	7	0.419E 03
F. TOXIC CHEMICAL WASTES	-DRUMS	2	0.235E 00	2	0.235E 00
F2 CAUSTICS	-KGS	1	0.180E 03	1	0.180E 03
F3 ORGANICS	-DRUMS	1	0.220E 00	1	0.220E 00
F4 WASTE PAINT & DYE	-KGS	6	0.239E 03	6	0.239E 03
F9 OTHER	-DRUMS	1	0.150E-01	1	0.150E-01

(continued)

TABLE F-2 (continued)

COLLECTION DISTRICT NUMBER 4 - WEST CENTRAL

RESIDUE TYPE		1977-NO. OF INDUSTRIES	RESIDUES	1983-NO. OF INDUSTRIES	RESIDUES
A. OILY WASTES	-KGS	5	0.680E 02	5	0.680E 02
A1 WWT SLUDGES	-KGS	5	0.680E 02	5	0.680E 02
B. WASTE SOLVENTS	-KGS	2	0.680E 02	2	0.680E 02
B. WASTE SOLVENTS	-DRUMS	1	0.200E 01	1	0.200E 01
B1 PAINT MANUF.	-KGS	1	0.290E 02	1	0.290E 02
B1 PAINT MANUF.	-DRUMS	1	0.200E 01	1	0.200E 01
B3 METAL CLEANING	-KGS	1	0.390E 02	1	0.390E 02
C. ORGANIC RESIDUES	-KGS	4	0.215E 05	4	0.353E 05
C4 MUNICIPAL WWT	-KGS	4	0.215E 05	4	0.353E 05
D. HEAVY METAL CONTAINING	-KGS	8	0.384E 05	8	0.384E 05
D2 METAL FINISHING	-KGS	1	0.530E 02	1	0.530E 02
D5 AIR POL CONT DUSTS	-KGS	1	0.190E 05	1	0.190E 05
D6 SCRUBBER SLUDGES	-KGS	1	0.150E 05	1	0.150E 05
D7 SCALE	-KGS	4	0.778E 03	4	0.778E 03
D8 FOUNDRY SAND+METALLICS	-KGS	1	0.360E 04	1	0.360E 04
E. INORGANIC RESIDUES	-KGS	9	0.128E 07	10	0.189E 07
E1 FOUNDRY SAND	-KGS	1	0.450E 05	1	0.450E 05
E2 IRON SLAG	-KGS	1	0.310E 06	1	0.310E 06
E4 FGD SLUDGES	-KGS	0	0.000E 00	1	0.610E 06
E6 CEMENT DUSTS	-KGS	1	0.360E 05	1	0.360E 05
E7 WATER TRT. SLUDGES	-KGS	5	0.290E 06	5	0.290E 06
E8 FLY ASH	-KGS	1	0.600E 06	1	0.600E 06
F. TOXIC CHEMICAL WASTES.	-KGS	6	0.349E 05	6	0.349E 05
F2 CAUSTICS	-KGS	1	0.630E 04	1	0.630E 04
F3 ORGANICS	-KGS	3	0.227E 05	3	0.227E 05
F4 WASTE PAINT & DYE	-KGS	1	0.190E 01	1	0.190E 01
F6 COKE PROD. SLUDGES	-KGS	1	0.590E 04	1	0.590E 04

(continued)

TABLE F-2 (continued)

COLLECTION DISTRICT NUMBER 5 - NORTHWEST

RESIDUE TYPE		1977-NO. OF INDUSTRIES	RESIDUES	1983-NO. OF INDUSTRIES	RESIDUES
A. OILY WASTES	-KGS	4	0.195E 02	4	0.195E 02
A1 WWT SLUDGES	-KGS	3	0.130E 02	3	0.130E 02
A6 CUTTING OIL	-KGS	1	0.660E 01	1	0.660E 01
B. WASTE SOLVENTS	-KGS	1	0.230E 01	1	0.230E 01
B4 PRINTING, LITHO.	-KGS	1	0.230E 01	1	0.230E 01
C. ORGANIC RESIDUES	-KGS	6	0.242E 05	6	0.242E 05
C4 MUNICIPAL WWT	-KGS	6	0.242E 05	6	0.242E 05
D. HEAVY METAL CONTAINING	-KGS	3	0.217E 03	3	0.217E 03
D3 SPENT PIC LIQ-H2SO4	-KGS	1	0.170E 03	1	0.170E 03
D7 SCALE	-KGS	2	0.475E 02	2	0.475E 02
E. INORGANIC RESIDUES	-KGS	2	0.103E 06	2	0.103E 06
E7 WATER TRT. SLUDGES	-KGS	2	0.103E 06	2	0.103E 06

(continued)

TABLE F-2 (continued)

COLLECTION DISTRICT NUMBER 6 - NORTHEAST

RESIDUE TYPE		1977-NO. OF INDUSTRIES	RESIDUES	1983-NO. OF INDUSTRIES	RESIDUES
A. OILY WASTES	-KGS	2	0.950E 01	2	0.950E 01
A1 WWT SLUDGES	-KGS	1	0.470E 01	1	0.470E 01
A2 MACHINERY LUBRICANTS	-KGS	1	0.480E 01	1	0.480E 01
B. WASTE SOLVENTS	-KGS	3	0.465E 04	3	0.465E 04
B. WASTE SOLVENTS	-DRUMS	2	0.359E 01	2	0.359E 01
B1 PAINT MANUF.	-KGS	3	0.465E 04	3	0.465E 04
B1 PAINT MANUF.	-DRUMS	1	0.330E 01	1	0.330E 01
B3 METAL CLEANING	-DRUMS	1	0.290E 00	1	0.290E 00
C. ORGANIC RESIDUES	-KGS	6	0.485E 06	6	0.491E 06
C1 FOOD PROCESSING	-KGS	1	0.670E 02	1	0.700E 02
C3 COAL FINES	-KGS	1	0.470E 06	1	0.470E 06
C4 MUNICIPAL WWT	-KGS	4	0.151E 05	4	0.210E 05
D. HEAVY METAL CONTAINING	-KGS	8	0.120E 06	8	0.120E 06
D1 IRON HYDROXIDES	-KGS	1	0.100E 05	1	0.100E 05
D2 METAL FINISHING	-KGS	1	0.650E 04	1	0.650E 04
D3 SPENT PIC LIQ-H2SO4	-KGS	1	0.910E 05	1	0.910E 05
D6 SCRUBBER SLUDGES	-KGS	1	0.650E 04	1	0.650E 04
D7 SCALE	-KGS	1	0.650E 04	1	0.650E 04
D8 FOUNDRY SAND+METALLICS	-KGS	2	0.184E 03	2	0.184E 03
D9 OTHER	-KGS	1	0.400E 02	1	0.400E 02
E. INORGANIC RESIDUES	-KGS	16	0.885E 06	18	0.147E 07
E1 FOUNDRY SAND	-KGS	3	0.226E 04	3	0.226E 04
E2 IRON SLAG	-KGS	1	0.500E 04	1	0.500E 04
E3 STEEL SLAG	-KGS	1	0.130E 06	1	0.130E 06
E4 FGD SLUDGES	-KGS	0	0.000E 00	1	0.580E 06
E5 CULLET, GLASS MANUF.	-KGS	1	0.360E 04	1	0.500E 04
E6 CEMENT DUSTS	-KGS	1	0.110E 02	2	0.251E 03
E7 WATER TRT. SLUDGES	-KGS	8	0.174E 06	8	0.179E 06
E8 FLY ASH	-KGS	1	0.570E 06	1	0.570E 06

(continued)

TABLE F-2 (continued)

F. TOXIC CHEMICAL WASTES	-KGS	4	0.412E 04	4	0.412E 04
F. TOXIC CHEMICAL WASTES	-DRUMS	1	0.640E 01	1	0.640E 01
F2 CAUSTICS	-KGS	1	0.220E 04	1	0.220E 04
F4 WASTE PAINT & DYE	-KGS	2	0.234E 02	2	0.234E 02
F4 WASTE PAINT & DYE	-DRUMS	1	0.640E 01	1	0.640E 01
F5 INORGANICS	-KGS	1	0.190E 04	1	0.190E 04

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TABLE F-2 (continued)

RESIDUE TYPE	COLLECTION DISTRICT NUMBER	7 - EAST 1977-NO. OF INDUSTRIES	RESIDUES	1983-NO. OF INDUSTRIES	RESIDUES
A. OILY WASTES	-KGS	7	0.276E 04	7	0.286E 04
A1 WWT SLUDGES	-KGS	3	0.981E 02	3	0.984E 02
A4 EMULSIONS	-KGS	1	0.160E 03	1	0.160E 03
A5 ANIMAL OILS & FATS	-KGS	1	0.250E 03	1	0.250E 03
A6 CUTTING OIL	-KGS	2	0.225E 04	2	0.235E 04
B. WASTE SOLVENTS	-KGS	1	0.510E 03	1	0.510E 03
B. WASTE SOLVENTS	-DRUMS	1	0.100E 01	1	0.100E 01
B1 PAINT MANUF.	-DRUMS	1	0.100E 01	1	0.100E 01
B3 METAL CLEANING	-KGS	1	0.510E 03	1	0.510E 03
C. ORGANIC RESIDUES	-KGS	15	0.313E 06	15	0.314E 06
C1 FOOD PROCESSING	-KGS	2	0.161E 05	2	0.161E 05
C3 COAL FINES	-KGS	1	0.260E 06	1	0.260E 06
C4 MUNICIPAL WWT	-KGS	9	0.369E 05	9	0.379E 05
C5 CLEANING EMULSIONS	-KGS	3	0.396E 03	3	0.396E 03
D. HEAVY METAL CONTAINING	-KGS	12	0.114E 05	12	0.335E 05
D1 IRON HYDROXIDES	-KGS	1	0.420E 03	1	0.420E 03
D2 METAL FINISHING	-KGS	2	0.223E 04	2	0.223E 04
D5 AIR POL CONT DUSTS	-KGS	1	0.150E 02	1	0.150E 02
D6 SCRUBBER SLUDGES	-KGS	1	0.120E 04	1	0.120E 04
D7 SCALE	-KGS	3	0.517E 03	3	0.225E 05
D8 FOUNDRY SAND+METALLICS	-KGS	3	0.615E 04	3	0.627E 04
D9 OTHER	-KGS	1	0.880E 03	1	0.880E 03
E. INORGANIC RESIDUES	-KGS	9	0.204E 07	9	0.205E 07
E1 FOUNDRY SAND	-KGS	2	0.930E 04	2	0.930E 04
E2 IRON SLAG	-KGS	1	0.120E 07	1	0.120E 07
E3 STEEL SLAG	-KGS	2	0.695E 06	2	0.695E 06
E6 CEMENT DUSTS	-KGS	1	0.670E 05	1	0.670E 05
E7 WATER TRT. SLUDGES	-KGS	3	0.768E 05	3	0.789E 05
F. TOXIC CHEMICAL WASTES	-KGS	1	0.120E 04	1	0.120E 04
F. TOXIC CHEMICAL WASTES	-DRUMS	1	0.100E 00	1	0.100E 00
F4 WASTE PAINT & DYE	-DRUMS	1	0.100E 00	1	0.100E 00
F5 INORGANICS	-KGS	1	0.120E 04	1	0.120E 04

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TABLE F-2 (continued)

COLLECTION DISTRICT NUMBER 8 - SOUTHEAST

RESIDUE TYPE		1977-NO. OF INDUSTRIES	RESIDUES	1983-NO. OF INDUSTRIES	RESIDUES
A. OILY WASTES	-KGS	6	0.495E 04	6	0.605E 04
A1 WWT SLUDGES	-KGS	4	0.253E 03	4	0.253E 03
A6 CUTTING OIL	-KGS	1	0.230E 04	1	0.230E 04
A7 TANK BOTTOMS	-KGS	1	0.240E 04	1	0.350E 04
C. ORGANIC RESIDUES	-KGS	6	0.133E 05	6	0.169E 05
C4 MUNICIPAL WWT	-KGS	6	0.133E 05	6	0.169E 05
D. HEAVY METAL CONTAINING	-KGS	16	0.126E 06	16	0.445E 06
D1 IRON HYDROXIDES	-KGS	1	0.000E 00	1	0.270E 06
D2 METAL FINISHING	-KGS	2	0.183E 04	2	0.183E 04
D3 SPENT PIC LIQ-H2SO4	-KGS	1	0.110E 06	1	0.110E 06
D6 SCRUBBER SLUDGES	-KGS	2	0.113E 05	2	0.113E 05
D7 SCALE	-KGS	5	0.817E 01	5	0.500E 05
D8 FOUNDRY SAND+METALLICS	-KGS	3	0.245E 04	3	0.210E 04
D9 OTHER	-KGS	2	0.670E 03	2	0.670E 03
E. INORGANIC RESIDUES	-KGS	5	0.609E 06	5	0.609E 06
E1 FOUNDRY SAND	-KGS	2	0.193E 05	2	0.193E 05
E2 IRON SLAG	-KGS	1	0.550E 06	1	0.550E 06
E7 WATER TRT. SLUDGES	-KGS	1	0.200E 04	1	0.200E 04
E8 FLY ASH	-KGS	1	0.380E 05	1	0.380E 05
F. TOXIC CHEMICAL WASTES	-KGS	5	0.529E 05	5	0.539E 05
F1 ACIDS	-KGS	2	0.102E 02	2	0.102E 02
F5 INORGANICS	-KGS	1	0.900E 03	1	0.900E 03
F6 COKE PROD. SLUDGES	-KGS	1	0.330E 05	1	0.340E 05
F7 PITCH SAND, TAR	-KGS	1	0.190E 05	1	0.190E 05

(continued)

TABLE F-2 (continued)

COLLECTION DISTRICT NUMBER 9 - SOUTH

RESIDUE TYPE		1977-NO. OF INDUSTRIES	RESIDUES	1983-NO. OF INDUSTRIES	RESIDUES
A. OILY WASTES	-KGS	3	0.206E 05	3	0.216E 05
A1 WWT SLUDGES	-KGS	2	0.631E 03	2	0.631E 03
A6 CUTTING OIL	-KGS	1	0.200E 05	1	0.210E 05
B. WASTE SOLVENTS	-DRUMS	1	0.200E 01	1	0.200E 01
B4 PRINTING, LITHO.	-DRUMS	1	0.200E 01	1	0.200E 01
C. ORGANIC RESIDUES	-KGS	7	0.318E 05	7	0.438E 05
C4 MUNICIPAL WWT	-KGS	6	0.318E 05	6	0.438E 05
C5 CLEANING EMULSIONS	-KGS	1	0.220E 02	1	0.230E 02
D. HEAVY METAL CONTAINING	-KGS	5	0.159E 07	5	0.219E 07
D1 IRON HYDROXIDES	-KGS	1	0.110E 07	1	0.160E 07
D2 METAL FINISHING	-KGS	1	0.420E 05	1	0.420E 05
D6 SCRUBBER SLUDGES	-KGS	1	0.450E 06	1	0.460E 06
D7 SCALE	-KGS	1	0.000E 00	1	0.910E 05
D9 OTHER	-KGS	1	0.000E 00	1	0.000E 00
E. INORGANIC RESIDUES	-KGS	1	0.180E 05	1	0.180E 05
E8 FLY ASH	-KGS	1	0.180E 05	1	0.180E 05

(continued)

TABLE F-2 (continued)

COLLECTION DISTRICT NUMBER 10 - WEST

RESIDUE TYPE		1977-NO. OF INDUSTRIES	RESIDUES	1983-NO. OF INDUSTRIES	RESIDUES
A. OILY WASTES	-KGS	4	0.268E 03	4	0.268E 03
A1 WWT SLUDGES	-KGS	2	0.930E 02	2	0.930E 02
A6 CUTTING OIL	-KGS	2	0.175E 03	2	0.175E 03
B. WASTE SOLVENTS	-KGS	2	0.301E 03	2	0.301E 03
B. WASTE SOLVENTS	-DRUMS	1	0.120E 01	1	0.120E 01
B1 PAINT MANUF.	-KGS	1	0.300E 03	1	0.300E 03
B3 METAL CLEANING	-DRUMS	1	0.120E 01	1	0.120E 01
B4 PRINTING, LITHO.	-KGS	1	0.120E 01	1	0.120E 01
C. ORGANIC RESIDUES	-KGS	8	0.594E 05	10	0.647E 05
C1 FOOD PROCESSING	-KGS	0	0.000E 00	1	0.450E 01
C3 COAL FINES	-KGS	1	0.390E 05	1	0.390E 05
C4 MUNICIPAL WWT	-KGS	6	0.202E 05	6	0.229E 05
C5 CLEANING EMULSIONS	-KGS	1	0.150E 03	2	0.275E 04
D. HEAVY METAL CONTAINING	-KGS	8	0.200E 05	8	0.200E 05
D2 METAL FINISHING	-KGS	2	0.130E 05	2	0.130E 05
D3 SPENT PIC LIQ-H2SO4	-KGS	4	0.682E 04	4	0.682E 04
D7 SCALE	-KGS	2	0.195E 03	2	0.195E 03
E. INORGANIC RESIDUES	-KGS	5	0.110E 07	5	0.110E 07
E4 FGD SLUDGES	-KGS	1	0.510E 06	1	0.510E 06
E7 WATER TRT. SLUDGES	-KGS	3	0.920E 05	3	0.920E 05
E8 FLY ASH	-KGS	1	0.500E 06	1	0.500E 06
F. TOXIC CHEMICAL WASTES	-KGS	2	0.650E 03	2	0.650E 03
F2 CAUSTICS	-KGS	1	0.630E 03	1	0.630E 03
F4 WASTE PAINT & DYE	-KGS	1	0.200E 02	1	0.200E 02

(continued)

TABLE F-2 (continued)

RESIDUE TYPE	COUNTY TOTALS	1977-NO. OF INDUSTRIES	RESIDUES	1983-NO. OF INDUSTRIES	RESIDUES
A. OILY WASTES	-KGS	59	0.556E 05	59	0.628E 05
A. OILY WASTES	-DRUMS	1	0.550E-01	1	0.550E-01
A1 WWT SLUDGES	-KGS	34	0.231E 04	34	0.231E 04
A1 WWT SLUDGES	-DRUMS	0	0.000E 00	0	0.000E 00
A2 MACHINERY LUBRICANTS	-KGS	3	0.167E 03	3	0.167E 03
A2 MACHINERY LUBRICANTS	-DRUMS	0	0.000E 00	0	0.000E 00
A3 HYDRAULIC OILS	-KGS	0	0.000E 00	0	0.000E 00
A3 HYDRAULIC OILS	-DRUMS	0	0.000E 00	0	0.000E 00
A4 EMULSIONS	-KGS	4	0.404E 04	4	0.404E 04
A4 EMULSIONS	-DRUMS	1	0.550E-01	1	0.550E-01
A5 ANIMAL OILS & FATS	-KGS	5	0.157E 04	5	0.157E 04
A5 ANIMAL OILS & FATS	-DRUMS	0	0.000E 00	0	0.000E 00
A6 CUTTING OIL	-KGS	12	0.451E 05	12	0.511E 05
A6 CUTTING OIL	-DRUMS	0	0.000E 00	0	0.000E 00
A7 TANK BOTTOMS	-KGS	1	0.240E 04	1	0.350E 04
A7 TANK BOTTOMS	-DRUMS	0	0.000E 00	0	0.000E 00
A8	-KGS	0	0.000E 00	0	0.000E 00
A8	-DRUMS	0	0.000E 00	0	0.000E 00
A9 OTHER	-KGS	0	0.000E 00	0	0.000E 00
A9 OTHER	-DRUMS	0	0.000E 00	0	0.000E 00
B. WASTE SOLVENTS	-KGS	18	0.852E 04	18	0.852E 04
B. WASTE SOLVENTS	-DRUMS	8	0.139E 02	8	0.139E 02
B1 PAINT MANUF.	-KGS	13	0.791E 04	13	0.791E 04
B1 PAINT MANUF.	-DRUMS	3	0.630E 01	3	0.630E 01
B2 RESIN MANUF.	-KGS	0	0.000E 00	0	0.000E 00
B2 RESIN MANUF.	-DRUMS	1	0.330E 01	1	0.330E 01
B3 METAL CLEANING	-KGS	3	0.612E 03	3	0.612E 03
B3 METAL CLEANING	-DRUMS	2	0.149E 01	2	0.149E 01
B4 PRINTING, LITHO.	-KGS	2	0.350E 01	2	0.350E 01
B4 PRINTING, LITHO.	-DRUMS	2	0.282E 01	2	0.282E 01
B5 SLUDGE	-KGS	0	0.000E 00	0	0.000E 00
B5 SLUDGE	-DRUMS	0	0.000E 00	0	0.000E 00

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TABLE F-2 (continued)

COUNTY TOTALS

RESIDUE TYPE		1977-NO. OF INDUSTRIES	RESIDUES	1983-NO. OF INDUSTRIES	RESIDUES
B6	-KGS	0	0.000E 00	0	0.000E 00
B6	-DRUMS	0	0.000E 00	0	0.000E 00
B7	-KGS	0	0.000E 00	0	0.000E 00
B7	-DRUMS	0	0.000E 00	0	0.000E 00
B8	-KGS	0	0.000E 00	0	0.000E 00
B8	-DRUMS	0	0.000E 00	0	0.000E 00
B9 OTHER	-KGS	0	0.000E 00	0	0.000E 00
B9 OTHER	-DRUMS	0	0.000E 00	0	0.000E 00
C. ORGANIC RESIDUES	-KGS	61	0.143E 07	63	0.147E 07
C. ORGANIC RESIDUES	-DRUMS	1	0.660E-01	1	0.660E-01
C1 FOOD PROCESSING	-KGS	5	0.165E 05	6	0.165E 05
C1 FOOD PROCESSING	-DRUMS	0	0.000E 00	0	0.000E 00
C2 PHARMACEUTICALS	-KGS	0	0.000E 00	0	0.000E 00
C2 PHARMACEUTICALS	-DRUMS	0	0.000E 00	0	0.000E 00
C3 COAL FINES	-KGS	3	0.769E 06	3	0.769E 06
C3 COAL FINES	-DRUMS	0	0.000E 00	0	0.000E 00
C4 MUNICIPAL WWT	-KGS	43	0.643E 06	43	0.684E 06
C4 MUNICIPAL WWT	-DRUMS	0	0.000E 00	0	0.000E 00
C5 CLEANING EMULSIONS	-KGS	9	0.380E 04	10	0.650E 04
C5 CLEANING EMULSIONS	-DRUMS	0	0.000E 00	0	0.000E 00
C6	-KGS	0	0.000E 00	0	0.000E 00
C6	-DRUMS	0	0.000E 00	0	0.000E 00
C7	-KGS	0	0.000E 00	0	0.000E 00
C7	-DRUMS	0	0.000E 00	0	0.000E 00
C8	-KGS	0	0.000E 00	0	0.000E 00
C8	-DRUMS	0	0.000E 00	0	0.000E 00
C9 OTHER	-KGS	1	0.370E 02	1	0.370E 02
C9 OTHER	-DRUMS	1	0.660E-01	1	0.660E-01
D. HEAVY METAL CONTAINING	-KGS	110	0.212E 07	112	0.342E 07
D. HEAVY METAL CONTAINING	-DRUMS	1	0.160E-01	1	0.160E-01
D1 IRON HYDROXIDES	-KGS	6	0.111E 07	7	0.215E 07
D1 IRON HYDROXIDES	-DRUMS	0	0.000E 00	0	0.000E 00

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TABLE F-2 (continued)

RESIDUE TYPE	COUNTY TOTALS	1977-NO. OF INDUSTRIES	RESIDUES	1983-NO. OF INDUSTRIES	RESIDUES
D2 METAL FINISHING	-KGS	18	0.912E 05	18	0.917E 05
D2 METAL FINISHING	-DRUMS	0	0.000E 00	0	0.000E 00
D3 SPENT PIC LIQ-H2SO4	-KGS	15	0.313E 06	15	0.313E 06
D3 SPENT PIC LIQ-H2SO4	-DRUMS	0	0.000E 00	0	0.000E 00
D4 SPENT PIC LIQ-HCL	-KGS	0	0.000E 00	0	0.000E 00
D4 SPENT PIC LIQ-HCL	-DRUMS	0	0.000E 00	0	0.000E 00
D5 AIR POL CONT DUSTS	-KGS	4	0.615E 05	4	0.445E 05
D5 AIR POL CONT DUSTS	-DRUMS	1	0.160E-01	1	0.160E-01
D6 SCRUBBER SLUDGES	-KGS	11	0.518E 06	11	0.524E 06
D6 SCRUBBER SLUDGES	-DRUMS	0	0.000E 00	0	0.000E 00
D7 SCALE	-KGS	27	0.979E 04	28	0.279E 06
D7 SCALE	-DRUMS	0	0.000E 00	0	0.000E 00
D8 FOUNDRY SAND+METALLICS	-KGS	24	0.191E 05	24	0.203E 05
D8 FOUNDRY SAND+METALLICS	-DRUMS	0	0.000E 00	0	0.000E 00
D9 OTHER	-KGS	5	0.159E 04	5	0.159E 04
D9 OTHER	-DRUMS	0	0.000E 00	0	0.000E 00
E. INORGANIC RESIDUES	-KGS	88	0.116E 08	92	0.109E 08
E. INORGANIC RESIDUES	-DRUMS	1	0.440E-01	1	0.440E-01
E1 FOUNDRY SAND	-KGS	25	0.965E 05	25	0.965E 05
E1 FOUNDRY SAND	-DRUMS	0	0.000E 00	0	0.000E 00
E2 IRON SLAG	-KGS	10	0.430E 07	10	0.342E 07
E2 IRON SLAG	-DRUMS	0	0.000E 00	0	0.000E 00
E3 STEEL SLAG	-KGS	8	0.328E 07	8	0.224E 07
E3 STEEL SLAG	-DRUMS	0	0.000E 00	0	0.000E 00
E4 FGD SLUDGES	-KGS	1	0.510E 06	3	0.170E 07
E4 FGD SLUDGES	-DRUMS	0	0.000E 00	0	0.000E 00
E5 CULLET, GLASS MANUF.	-KGS	3	0.425E 04	4	0.568E 04
E5 CULLET, GLASS MANUF.	-DRUMS	0	0.000E 00	0	0.000E 00
E6 CEMENT DUSTS	-KGS	5	0.109E 06	6	0.109E 06
E6 CEMENT DUSTS	-DRUMS	0	0.000E 00	0	0.000E 00
E7 WATER TRT. SLUDGES	-KGS	28	0.159E 07	28	0.163E 07
E7 WATER TRT. SLUDGES	-DRUMS	0	0.000E 00	0	0.000E 00

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TABLE F-2 (continued)

COUNTY TOTALS

RESIDUE TYPE		1977-NO. OF INDUSTRIES	RESIDUES	1983-NO. OF INDUSTRIES	RESIDUES
E8 FLY ASH	-KGS	8	0.175E 07	8	0.175E 07
E8 FLY ASH	-DRUMS	0	0.000E 00	0	0.000E 00
E9 OTHER	-KGS	0	0.000E 00	0	0.000E 00
E9 OTHER	-DRUMS	1	0.440E-01	1	0.440E-01
F. TOXIC CHEMICAL WASTES	-KGS	32	0.958E 05	32	0.142E 06
F. TOXIC CHEMICAL WASTES	-DRUMS	5	0.187E 02	5	0.187E 02
F1 ACIDS	-KGS	2	0.102E 02	2	0.102E 02
F1 ACIDS	-DRUMS	0	0.000E 00	0	0.000E 00
F2 CAUSTICS	-KGS	6	0.934E 04	6	0.934E 04
F2 CAUSTICS	-DRUMS	0	0.000E 00	0	0.000E 00
F3 ORGANICS	-KGS	4	0.227E 05	4	0.227E 05
F3 ORGANICS	-DRUMS	1	0.220E 00	1	0.220E 00
F4 WASTE PAINT & DYE	-KGS	12	0.309E 03	12	0.309E 03
F4 WASTE PAINT & DYE	-DRUMS	3	0.185E 02	3	0.185E 02
F5 INORGANICS	-KGS	3	0.400E 04	3	0.400E 04
F5 INORGANICS	-DRUMS	0	0.000E 00	0	0.000E 00

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TABLE F-2 (continued)

COUNTY TOTALS

RESIDUE TYPE		1977-NO. OF INDUSTRIES	RESIDUES	1983-NO. OF INDUSTRIES	RESIDUES
F6 COKE PROD. SLUDGES	-KGS	3	0.389E 05	3	0.859E 05
F6 COKE PROD. SLUDGES	-DRUMS	0	0.000E 00	0	0.000E 00
F7 PITCH SAND, TAR	-KGS	2	0.205E 05	2	0.205E 05
F7 PITCH SAND, TAR	-DRUMS	0	0.000E 00	0	0.000E 00
F8	-KGS	0	0.000E 00	0	0.000E 00
F8	-DRUMS	0	0.000E 00	0	0.000E 00
F9 OTHER	-KGS	0	0.000E 00	0	0.000E 00
F9 OTHER	-DRUMS	1	0.150E-01	1	0.150E-01

APPENDIX G

ALTERNATIVE AIR POLLUTION CONTROL RESIDUE ANALYSIS

APPENDIX G

ALTERNATIVE ANALYSIS OF RESIDUE GENERATION RESULTING FROM AIR POLLUTION CONTROL REQUIREMENTS

Summary

An alternative method for estimating total potential air pollution control residues is presented in this section. Based on current state and federal legislative requirements, residues from air pollution control, including scrubber sludges, dusts and flue gas desulfurization (FGD) sludges, were estimated for current and future conditions. A list of those industrial sectors identified and investigated as potential generators of air pollution control residues appears in Table 4. The quantities determined were as follows:

	(tons/day) Current	(tons/day) Future
APC dusts	970	1000
Scrubber sludges	560	560
FGD sludges	1300	1900

Of these amounts, heavy-metal containing residues were estimated as follows:

	(tons/day) Current	(tons/day) Future
APC dust	680	680
Scrubber sludges	530	530

It is estimated that 95% of the scrubber sludges and about 70% of the APC dusts currently generated in the county contain heavy metals.

Impact of Legislation

An analysis of the requirements of current legislation of Pennsylvania (20, 21) and the U.S. Environmental Protection Agency (22, 23) was performed in relation to its impact on APC residues generation. In general, allowable emissions promulgated by regulatory agencies have been based on feed or production rates for specific industries.

Some New Source Performance Standards have been formulated on a different basis of exhaust gas loadings (grains/dry standard cubic foot) and/or

TABLE G-1. INDUSTRIAL SECTORS INVESTIGATED FOR AIR POLLUTION CONTROL RESIDUES

SIC*	Short Title
2013	Sausages & Other Prepared Meat Products
2819	Industrial Inorganic Chemicals, NEC**
2851	Paints, Varnishes, Lacquers, Enamels, & Allied Products
2874	Phosphatic Fertilizers
2911	Petroleum Refining
2951	Paving Mixtures & Blocks
2952	Asphalt Felts & Coatings
3011	Tires & Inner Tubes
3211	Flat Glass
3221	Glass Containers
3229	Pressed & Blown Glass & Glassware, NEC**
3231	Glass Products, Made of Purchased Glass
3241	Cement, Hydraulic
3296	Mineral Wool
3312	Blast Furnaces, Coke Ovens, & Steel Works
3313	Electrometallurgical Products
3316	Cold Rolled Steel Sheet, Strip, & Bars
3321	Gray Iron Foundries
3325	Steel Foundries, NEC**
3333	Primary Smelting & Refining of Zinc
3341	Secondary Smelting & Refining of Non-Ferrous Metals
3361	Aluminum Foundries (Castings)
3362	Brass, Bronze, Copper, & Copper-Base Alloy Foundries (Castings)
3369	Nonferrous Foundries, NEC**
3398	Metal Heat Treating
3399	Primary Metal Products, NEC**
3429	Hardware, NEC**
3441	Fabricated Structural Metal
3443	Fabricated Plate Work (Boiler Shops)
3452	Bolts, Nuts, Screws, Rivets, & Washers
3479	Coating, Engraving, & Allied Services, NEC
3545	Machine Tool Accessories & Measuring Devices
3612	Power, Distribution, & Specialty Transformers
4911	Electric Services

* SIC = Standard Industrial Classification Code.
** NEC = Not Elsewhere Classified.

percent opacity. The expression of these standards in this manner complicates the survey and requires a level of detail beyond the scope of this analysis. For example, a boiler inventory would be required to provide such details as location, heat input rates, characteristics and types of fuels, type of firing system, control technique(s) applied, effluent gas loadings before control, removal efficiencies, etc. As a result, a simplified approach was developed, as described below.

APC residue generating industries were initially identified by a review of data collected from industries, by review of the literature (24), and by associating manufacturing processes currently under state regulation with their respective industrial categories. In some cases, the impact of legislation on the generation of current and future APC residue quantities and types was obtained directly from specific plants. In the remaining cases, the effects of current legislative requirements on APC residue generation was estimated by assuming that plants will emit the maximum amount of pollutants allowed by Pennsylvania, and that the current daily residue generated by air pollution control systems would be equal to: (1) the equivalent uncontrolled daily generation estimated from the literature less the allowable daily emission; or (2) the equivalent uncontrolled daily generation multiplied by the percent removal attributable to an average or typical control technology identified in the literature and assumed to be employed in order to meet current requirements.

Future APC residues generation was assumed to be attributable to the application of the highest level of available control technology identified (24). Thus the highest percent removal was applied to the estimated uncontrolled daily generation referred to previously to give the amount of APC residues generated. Future residue amounts will represent only a slight increase over current quantities inasmuch as current control technologies already represent high levels of removal.

Methodology

The above discussion of the impact of legislative requirements on the generation of APC residues provides a general framework within which a more detailed method of calculating APC residues was based. A summary of the methodology used is given below.

As stated previously, an inventory of all boilers and incinerators was beyond the level of detail of this study. In addition, this effort would not likely reveal significant quantities of residues in light of the large quantities of residues from heavy industrial and power generating facilities in the area. Estimation of APC residues centered primarily on manufacturing industries and power plants, since these operations were expected to contribute the major, if not overwhelming, portion of the particulate and FGD sludge quantities.

Manufacturing processes for which particulate emissions are regulated were identified and were related to Standard Industrial Classification Code categories (see Table 5). Allowable Pennsylvania emissions were calculated by the following formula for each process:

$$A = 0.76\ E^{0.42}$$

Where:

A = Allowable emissions in lbs/hr
E = Emission index = $F \times W$ lbs/hr
F = Process factor in lbs/unit
W = Production or charging rate in units/hr

Process factors, F, were derived from the literature. No APC residue generation rates could be calculated where standards were set in terms of loadings of effluent gas (grains per dry standard cubic foot) due to a lack of uncontrolled loadings data. In addition, particulates from coal crushing, grinding, or screening were not considered air pollution control dusts per se. This material is adequately entrained by water and retained in lagoons on-site and was classed in a separate residue category (coal fines, C3) as a process by-product. Because production data were available or could be estimated for over 3/4 of the plants, the Allowable Emissions formula proved to be a useful tool in conjunction with the estimates of particulates generated before controls are applied as given (50, 24). Whenever alternative methods of calculation of APC residues existed, the alternative which gave the greatest quantities was chosen in order to provide conservative estimates.

Because the iron and steel and power industries generate a substantial portion of the APC residues, somewhat more emphasis was placed on these industries. A literature review was used to cross-check estimates which were also verified by personal contacts with EPA industrial pollution individuals. With this background, the following APC residue generation pattern for the iron and steel industries was postulated:

Operation	Avg. Uncontrolled Generation lb/1000 lb Product	% Recycled	APC Residues To Disposal lb/1000 lb Product
Coking	3.3	98	0.066
Sintering	15.0	98	0.030
Blast Furnace	46.4	80	9.28
Open Hearth	11.9	15	10.1
Electric Arc Furnace	14.5	NA*	14.5
Basic Oxygen Furnace	27.0	25	20.3

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*NA = Not Applicable

Estimates of FGD sludges from electric power plants were based on generation rates obtained from the literature and were verified by personal contract with individuals from the EPA. Assumptions were as follows:

1. All FGD systems are lime-based and are currently operational at all plant

2. Power plants operate at 75% capacity with 3% sulfur coal and a heating value of 11,000 BTU/lb and an ash value of 11%;

3. One megawatt (MW) equals 10^7 BTU/hr coal input; and

4. Coal-to-power conversion efficiency is 34%.

As a result of the above assumptions, FGD sludge generation rates were estimated to be on the order of 120-130 dry lb/hr for a 100 MW plant. Estimates were based on the assumption that all power plants fire coal and use FGD systems. While this may not be strictly true for current practices, it is anticipated that this will probably be true in the future due to increasing reliance on coal for power.

TABLE G-2. MANUFACTURING PROCESSES AND ASSOCIATED INDUSTRIAL SECTORS FOR WHICH ALLOWABLE PARTICULATE EMISSIONS FACTORS HAVE BEEN ESTABLISHED BY REGULATION

SIC*	Title	Processes regulated
2013	Sausages & Prepared Meats	Meat Smoking
2819	Industrial Inorganic Chemicals NEC**: Activated Charcoal Mfg.	Charcoal Mfg.
2841	Soap & Other Detergents	Detergent Drying
2851	Paints & Allied Products	Pigment Handling, Paint Mfg.
2861	Gum & Wood Chemicals: Charcoal Mfg.	Charcoal Mfg.
2873	Nitrogenous Fertilizers	Ammonium Nitrate Mfg: Granulator
2874	Phosphatic Fertilizers	Phosphoric Acid Mfg.
2895	Carbon Black	Carbon Black Mfg.
2911	Petroleum Refining	Catalytic Cracking
2951	Paving Mixtures & Blocks	Asphaltic Concrete Production
2952	Asphalt Felts & Coatings	Asphalt Roofing Mfg: Felt Saturation
3211	Flat Glass	Glass Production Melting Furnaces
3221	Pressed or Blown Glass Containers	
3229	Pressed or Blown Glass, NEC**	
3241	Hydraulic Cement	Portland Cement Mfg: Clinker Production, Clinker Cooling

(continued)

TABLE G-2 (continued)

SIC*	Title	Processes regulated
3274	Lime	Lime Calcining
3296	Mineral Wool: Fiberglass	Spun Glass: Glass Production Melting Furnaces
3312	Blast Furnaces & Steel Mills	Iron Production, Windbox Sintering, Steel Production, Scarfing
3313	Electrometallurgical Products	Ferroalloy Production Furnace
332	Iron & Steel Foundries	Iron Foundry: Melting, Sand Handling, Shake-out
3332	Primary Lead Production	Roasting, Windbox Sintering, Lead Reduction
3333	Primary Zinc Production	Roasting, Windbox Sintering, Zinc Reduction
3341	Secondary Nonferrous Metals	Secondary Aluminum: Sweating Brass & Bronze: Melting & Refining Secondary Lead Smelting Secondary Magnesium Smelting Secondary Zinc: Sweating, Refining

* = Standard Industrial Classification Code

** = Not elsewhere classified.

APPENDIX H

SUMMARY OF LEGISLATION AND REGULATORY CONSIDERATIONS

(A synopsis of local, state and federal rules and regulations which govern industrial residue disposal.)

APPENDIX H

SUMMARY OF LEGISLATION AND REGULATORY CONSIDERATIONS

COUNTY

Allegheny County Health Department, Rules and Regulations Article VIII - Solid Waste Management

This regulation establishes minimum standards for the collection, processing, storage and disposal of all types of solid wastes within the county, including ashes, slags, air pollution control residues, and hazardous wastes. Specific requirements of the regulations for all landfills include:

1. Annual permits for all solid waste processing and/or disposal operations.
2. Filing of background data on quantities, volumes, topographic maps and water pollution prevention.
3. Transportation permits for individual vehicles.
4. Design and construction standards: proximity to mines, oil and gas wells, water supplies and pipelines, lift dimensions, soil and geologic investigations, types of cover, access roads, measuring facilities and final grading and reclamation.
5. Operation, equipment and maintenance standards: safety, record-keeping, truck specifications, standby compaction equipment, daily and intermediate cover, dust control and open burning prohibitions.

Any individual, company or municipality desiring to process or dispose of hazardous wastes, liquids or sludges must have specific approval from the department of health. Sewage sludge must be digested and at least 20% solids. Stringent criteria established by the Department must be met for the disposal of any hazardous wastes, specifically oil sludges, pathological and biological wastes, radioactive material, poisons, acids, caustics, toxic chemicals and explosives.

STATE

Pennsylvania Solid Wastes Management

Title 25 Rules and Regulations

Part 1. Department of Environmental Resources

Subpart C. Protection of Natural Resources

Article I. Land Resources

Chapter 75. Solid Waste Management

This chapter is currently in the process of being revised and updated. Under the amended regulations, all solid waste disposal sites, including industrial residues, are required under this Title to obtain a permit from the Department of Environmental Resources. General standards pertaining to all sites regulate collection, design criteria, operation, environmental degradation, access roads, weighing, safety, reports, geological and hydrological investigations, land reclamation, monitoring, flooding hazards and buffer zones. Specific standards applicable to industrial residue disposal are out lines for incineration, hazardous wastes, sewage sludges, construction and demolition wastes, pesticide wastes and containers, solid waste disposal in mines, and fly ash. Specific requirements and classifications are included in the following:

Incineration--

1. Types and volumes of wastes accepted.
2. Waste analyses (moisture, volatile matter, heating values) must be performed.
3. Construction criteria.
4. Storage facilities.
5. Solid, liquid and gaseous effluent regulations.
6. Specific hazardous waste approvals.
7. Performance evaluations.

Hazardous Wastes--

1. Full disclosure of hazardous nature before transport.
2. Adequate transport safety assurances.
3. Specific approval for adequate storage site precautions.
4. Environmental acceptability of de-toxification and fixation facilities.
5. A comprehensive list of hazardous materials based on toxicity, flammability, pathogenicity and radioactivity. Specific handling and disposal requirements will be developed for many of the individual chemicals.
6. Disposal of designated hazardous wastes only at these specifically permitted hazardous waste disposal sites.

Sewage Sludge--

1. Land reclamation permit requirements; chemical analyses, maps, source, application rates and methods, and revegetation plans.
2. Agriculture utilization regulations.
3. Give-away regulations.
4. Landfill regulations: 20% solids, leachate treatment, digestion.

Pesticides--

1. Pertains to all pesticides defined in the Federal Insecticide, Fungicide, and Rodenticide Act.
2. Total inaccessibility of site to animals, humans.
3. Triple rinse of containers.
4. Clear marking of containers and adequate warnings to scrap dealers.
5. Isolation of site: 500' from streams, 4' from highest groundwater, 100' from bedrock, sinkholes, etc.
6. Incineration restrictions.
7. Disposal site liners.
8. Operator certification.

Mine Residue Disposal--

1. Posting of a bond for the assurance of operator responsibility, restoration, and continual maintenance of leachate collection facilities for 10 years after closure.

Fly Ash--

1. Detailed chemical analyses of fly ash and expected leachate.
2. Bearing capacity of geology foundation materials (1½ x total applied load).
3. Special design factors: clay horizons, saturated zones, subsidence.
4. 33% slope limitation, slope stabilization plans for 15% - 33%, terrace specifications.
5. Runoff diversion, collection, treatment.
6. Groundwater protection.
7 Restoration plan submission.
8. Operation requirements: controlled access, compaction, drainage, monitoring, special approval for inclusion of FGD sludge, continuous revegetation, post-closure maintenance.

Title 25 Rules and Regulations

Part 1 DER

Subpart C. Protection of Natural Resources

Article II. Water Resources

Chapter 100

The authority for establishing these regulations which govern disposal of residues generated in coal mining and preparation as well as land reclamation lies in these four State Acts:

Commonwealth of Pennsylvania Coal Refuse Disposal Control Act (September 24, 1968, P.L. 1040 and Amendments, 52 PS 30.51 et seq.)

Commonwealth of Pennsylvania Surface Mining Conservation & Reclamation Act (May 31, 1945, P.L. 1198, Act No. 418 and Amendments, including Laws of 1971, 52PS1396.1 et seq.)

Commonwealth of Pennsylvania Bituminous Mine Subsidence and Land Conservation Act of 1966.

Commonwealth of Pennsylvania Anthracite Strip Mining & Conservation Act (Pennsylvania Statutes Annotated, Title 52 - Mines & Mining Sections 681.1 through 681.22)

These regulations cover AMD neutralization sludges, black slurries from coal preparation plants as well as waste coal and inert materials from mining. Specific guidelines governing disposal of these mining-related residues include:

1. All refuse disposal areas and impoundments must be under permit by the Department of Environmental Resources.
2. A bond of up to $1000 per acre must be posted to insure regulation compliance.
3. Performance of a thorough geologic and hydrologic site investigation.
4. Water diversion, collection and treatment.
5. Slope, height, buffer zone limitations.
6. Erosion prevention and revegetation guidelines.
7. Operation regulations: compaction, final cover, limited access, fire prevention, activity reports.
8. Maintenance of the site for as long as necessary after closure.

FEDERAL

Public Law 94-580 "Resource Conservation & Recovery Act of 1976" (42 USC 6901)

One of the major provisions in this recently passed (October 21, 1976) amendment to the Solid Waste Disposal Act provides for a comprehensive program for hazardous wastes management. A hazardous waste is defined as that "which because of its quantity, concentration, or physical, chemical, or infectious characteristics may - (A) cause, or significantly contribute to serious irreversible, or incapacitating reversible, illness; or (B) pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported or disposed of, or otherwise managed." Specific requirements in the hazardous wastes regulations to be developed by the EPA by April 1978 include:

1. A listing of all wastes categorized as hazardous based on toxicity, persistence, degradability, tissue accumulation potential, flammability and corrosiveness. Criteria for the determination and ranking of hazardous compounds has been developed by the EPA in the 1973 "Report to Congress - Disposal of Hazardous Wastes"; the screening procedure is based on bioconcentration, flammability, reactivity, lethal dose expected to kill 50% of a test animal population, lethal concentration, dermal irritation, phytotoxicity and genetic changes. Types of wastes that were identified by the report as likely for inclusion in the listing appear in Table H-1.

2. Standards for hazardous waste generators to protect human health and the environment: recordkeeping on quantities and composition, labeling, containers, warnings to transporters and processors, and reports.

3. Regulations for transportation of hazardous materials.

4. Standards for hazardous waste treatment, storage and disposal facilities; records of all processing, design and construction, treatment methods, contingency plans, and operation and maintenance.

5. The establishment of a permit program for hazardous waste treatment, storage and disposal facilities: providing information on estimates of compositions, quantities and concentrations of hazardous materials, treatment and disposal site characteristics, time schedule for modifications and the basis for non-issuance or revocation of permits.

6. Guidelines for assistance to States in the development of individual hazardous waste management programs.

The act empowers designated EPA representatives to inspect records and facilities and obtain samples of wastes being handled. Fines of up to $25,000 per day are specified for first-time violators of any of these provisions and up to $50,000 per day for repeat violators. Compliance must be accomplished by 90 days after promulgation of the hazardous waste listing (July 1978).

Subtitle H of the Act authorizes $35,000,000 during fiscal year 1978 for research, development, demonstration and information programs on all aspects of solid waste management. Several subsections are directed towards various aspects of residue management and could provide further funding for a management program in Allegheny County:

(3) The planning, implementation, and operation of resource recovery and resource conservation systems and hazardous waste management systems, including the marketing of recovered resources.

(5) The reduction of the amount of waste and unsalvageable waste materials.

(11) Methods for the sound disposal of, or recovery of resources, including energy, from sludge (including sludge from pollution control and treatment facilities, coal slurry pipelines, and other sources).

(12) Methods of hazardous waste management, including methods of rendering such waste environmentally safe.

In addition, federal grants of up to 75% of design and construction cost for full scale area-wide resource recovery and improved solid waste handling facilities which will demonstrate new and improved technologies in reduction of environmental impacts and recycling materials are available.

Public Law 94-469 "Toxic Substances Control Act" (15 USC 2601)

Any chemical substance or mixture that presents an unreasonable risk to health or the environment by its manufacture, distribution in commerce, processing, use or disposal is subject to strict regulation by the terms of this Act, administered by the U.S. EPA. These regulations include extensive testing, notification of intent to manufacture or process the material, limitations on amounts to be processed, labeling, recordkeeping and modifications of processing for the protection of public health.

A listing of substances to be regulated under this Act will be promulgated within 12 months of enactment (enacted October 1976). Orders prohibiting or regulating the manner of disposal of any of these substances may be issued to any individuals involved. A set of rules regulating the processing of the designated materials will be promulgated by the EPA.

TABLE H-1. POTENTIALLY HAZARDOUS WASTES

Waste Stream Title	Standard Industrial Code
Aqueous inorganic:	
Chromate wastes from textile dyeing	22
Chlorine production brine sludges	2812
Potassium chromate production wastes	2819
Cellulose ester production wastes	2821
Intermediate agricultural product wastes (nitric acid)	287
Production works from ammonium sulfate	2873
Copper- and lead-bearing petroleum refinery wastes	291
Chrome tanning liquor	31
Mirror production wastes	3231
Cold finishing wastes	331
Consolidated steel plant wastes	331
Stainless steel pickling liquor	3312
Brass mill wastes	333
Metal finishing wastes	33
Aluminum anodizing bath with drag-out	
Brass plating wastes	
Cadmium plating wastes	
Chrome plating wastes	
Cyanide copper plating wastes	
Finishing effluents	
Metal cleaning wastes	
Plating preparation waste	
Silver plating wastes	
Zinc plating wastes	
Metal finishing chromic acid	34
Graphic arts and photography wastes	3555
Electronic circuitry manufacturing wastes	36
Aircraft plating wastes	372
Cooling tower blowdown	--
Organic:	
Cosynthesis methanol production wastes	2818
Formaldehyde production wastes	2818
n-Butane dehydrogenation butadiene production wastes	2818
Rubber manufacturing wastes	2822
Benzoic herbicide wastes (DOD)	2879
Chlorinated aliphatic herbicide wastes (DOD)	2879
Phenyl urea herbicide wastes (DOD)	2879
Halogenated aliphatic hydrocarbon fumigant wastes (DOD)	2879
Organophosphate pesticide wastes (DOD)	2879
Phenoxy herbicide wastes	2879

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TABLE H-1 (continued)

Waste Stream Title	Standard Industrial Code
Carbonate pesticide manufacturing (DOD)	2879
Polychlorinated hydrocarbon pesticide wastes (DOD)	2879
Miscellaneous organic pesticide manufacturing wastes (DOD)	2879
Contaminated and waste industrial propellants and explosives	2892
Contaminants and waste from primary explosives production	2892
Nitrocellulose base propellant contaminated waste	2892
High explosive contaminated wastes	2892
Incendiary contaminated wastes	2892
Production of nitroglycerin	2892
Solid waste from old primers and detonators	2892
Wastes from production of nitrocellulose propellants and smokeless powder	2892
Waste high explosives	2892
Waste incendiaries	2892
Waste nitrocellulose and smokeless powder	2892
Waste nitroglycerin	2892
Nonutility polychlorinated biphenyl wastes	2899
Gasoline blending wastes	2911
Reclaimers residues	2992
Coke plant raw waste	3312
Military arsenical wastes	9711
Outdated or contaminated tear gas	9711
Aqueous organic:	
Dimethyl sulfate production wastes	2611
Acetaldehyde via ethylene oxidation	281
Residue from manufacture of ethylene dichloride/vinyl chloride	2821
Nitrobenzene from rubber industry wastes	2822
Drug manufacturing wastes	283
Chlorinated hydrocarbon pesticide production wastes	2879
Miscellaneous organic herbicide production wastes	2879
Organo-phosphate pesticide production wastes	2879
Organic pesticide production wastes	2879
Phenoxy herbicide production wastes	2879

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TABLE H-1 (continued)

Waste Stream Title	Standard Industrial Code
Solid, slurry, or sludge	
Recovered arsenic from refinery flues (stored)	1021
Sodium dichromate production wastes	2819
Solvent-based paint sludge	285
Water-based paint sludge	285
Tetraethyl and tetramethyl lead production wastes	2869
Urea production wastes	2873
Benzoic herbicide contaminated containers	2879
Calcium arsenate contaminated containers	2879
Carbonate pesticide contaminated containers	2879
Chlorinated aliphatic pesticide contaminated containers	2879
Dinitro pesticide contaminated containers	2879
Lead arsenate contaminated containers	2879
Mercury fungicide contaminated containers	2879
Miscellaneous organic insecticide contaminated containers	2879
Organic arsenic contaminated containers	2879
Organic fungicide contaminated containers	2879
Organophosphorus contaminated containers	2879
Phenoxy contaminated containers	2879
Phenyl urea contaminated containers	2879
Polychlorinated hydrocarbon contaminated containers	2879
Triazine contaminated containers	2879
Miscellaneous organic pesticide contaminated containers	2879
Petroleum refining still bottoms	2911
Petroleum waste brine sludges	2911
Iron manufacturing waste sludge	331
Arsenic trioxide from smelting industry	333
Selenium production wastes	3339
Duplicating equipment manufacturing wastes	3555
Refrigeration equipment manufacturing wastes	3585
Battery manufacturing waste sludge	3691
Arsenic trichloride recovered from coal	49
Military paris green (stored)	9711
Stored military mercury compounds	9711
Aqueous inorganic (insufficient quantity or distribution data):	
Zinc ore roasting acid wash	1031
Mercury ore extraction wastes	1092
Cadmium ore extraction wastes	1099

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TABLE H-1 (continued)

Waste Stream Title	Standard Industrial Code
Mercury bearing textile wastes	22
Wastes from pulp and paper industry	26
Cadmium-selenium pigment wastes	28
Waste or contaminated perchloric acid	28
Arsine production wastes	2813
Borane production wastes	2813
Nickel carbonyl production wastes	2813
Waste bromine pentafluoride	2813
Waste chlorine pentafluoride	2813
Waste chlorine trifluoride	2813
Chromate wastes from pigments and dyes	2816
Arsenic wastes from purification of phosphoric acid	2819
Contaminated fluorine	2819
Cyanide production wastes	2819
Waste from manufacture of mercuric cyanide	2819
Waste from production of barium salts	2819
Urethane manufacturing wastes	2821
Wastes from polycarbonate polymer production	2821
Pharmaceutical arsenic wastes	283
Pharmaceutical mercurial wastes	283
Wood preservative wastes	2865
Contaminated antimony pentafluoride	2869
Contaminated antimony trifluoride	2869
Hydrazine production wastes	2869
Agricultural chemical production wastes	287
Agricultural pesticide arsenic wastes	2879
Mercuric fungicide production wastes	2879
Pesticide arsenate wastes	2879
Pesticide arsenic wastes	2879
1080 production wastes and contaminated lots	2879
Wastes from pesticide-herbicide manufacture (arsenites)	2879
Electrical fuse manufacturing wastes	2899
Beryllium salt production wastes	3339
Thallium production wastes	3339
Rotogravure printing plate wastes	3555
Computer manufacturing wastes	3573
Electronic tube production wastes	367
Magnetic tape production wastes	3679
Battery manufacturing wastes	3691
Mercury cell battery wastes	3692
Railroad engine cleaning	40
Arsenic wastes from transportation industry	40
Military cadmium wastes from plating	9711

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TABLE H-1 (continued)

Waste Stream Title	Standard Industrial Code
Military sodium chromate	9711
Organic (insufficient quantity or distribution data):	
Spent wood-preserving liquors	2491
Off-specification "agent orange" defoliant	9711
Aqueous organic (insufficient quantity or distribution data):	
Synthetic fiber production wastes	2824
Dye manufacturing wastes	2865
Nitrile pesticide wastes	2879
Organic arsenicals from production of cacodylates	2879
Torpedo process wastes	2879
Utilities and electrical station waste	49
Wastes from production of chloropicrin	9711
Solid, slurry, or sludge (insufficient quantity or distribution data):	
Wastes from seed industry	011
Contaminated orchard soil	0175
Old or contaminated thallium and thallium sulfate rodenticide	2879
Highly contaminated soil	9711
Spent filter media from military operations	9711
Waste chemicals from military	9711
Explosives from military ordnance	9711
Drugs and contraband seized by customs	--
Etiological materials from commercial production	--